Revised syllabus (Rev- 2016) from Academic Year 2016 -17

Under

FACULTY OF TECHNOLOGY

Computer Engineering

Second Year with Effect from AY 2017-18
Third Year with Effect from AY 2018-19
Final Year with Effect from AY 2019-20

As per Choice Based Credit and Grading System
with effect from the AY 2016–17
Program Structure B.E. Computer Engineering, (Rev. 2016) w.e.f. AY 2019-20

B.E. Computer Engineering (Semester-VII)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Teaching Scheme (Contact Hours)</th>
<th>Credits Assigned</th>
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<tr>
<td></td>
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<td>Theory</td>
<td>Pract</td>
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<td>Digital Signal &amp; Image Processing</td>
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<td>Mobile Communication &amp; Computing</td>
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University of Mumbai, B.E. (Computer Engineering), Rev. 2016
## B. E. Computer Engineering (Semester-VIII)

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### Examination Scheme

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Course Code | Course Name | Credits
----------|-------------|--------
CSC701     | Digital Signal & Image Processing | 4

Course objectives:
1. To understand the fundamental concepts of digital signal processing and Image processing.
2. To explore DFT for 1-D and 2-D signal and FFT for 1-D signal
3. To apply processing techniques on 1-D and Image signals.
4. To apply digital image processing techniques for edge detection.

Course outcomes: On successful completion of the course learner will be able to:
1. Apply the concept of DT Signal and DT Systems.
2. Classify and analyze discrete time signals and systems
3. Implement Digital Signal Transform techniques DFT and FFT.
4. Use the enhancement techniques for digital Image Processing
5. Differentiate between the advantages and disadvantages of different edge detection techniques

Prerequisite: Applied Mathematics

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<th>Module No.</th>
<th>Unit No.</th>
<th>Topic details</th>
<th>Hrs.</th>
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<tr>
<td>1.0</td>
<td>1.1</td>
<td>Introduction to Digital Signal Processing, Sampling and Reconstruction, Standard DT Signals, Concept of Digital Frequency, Representation of DT signal using Standard DT Signals, Signal Manipulations(shifting, reversal, scaling, addition, multiplication).</td>
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<td>Classification of Discrete-Time Signals, Classification of Discrete-Systems</td>
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<td>1.3</td>
<td>Linear Convolution formulation for 1-D and 2-D signal (without mathematical proof), Circular Convolution (without mathematical proof), Linear convolution using Circular Convolution. Auto and Cross Correlation formula evaluation, LTI system, Concept of Impulse Response and Step Response, Output of DT system using Time Domain Linear Convolution.</td>
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<td>Introduction to DTFT, DFT, Relation between DFT and DTFT, IDFT</td>
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<td>Properties of DFT without mathematical proof (Scaling and Linearity, Periodicity, Time Shift and Frequency Shift, Time Reversal, Convolution Property and Parsevals' Energy Theorem). DFT computation using DFT properties.</td>
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<td>Transfer function of DT System in frequency domain using DFT. Linear and Circular Convolution using DFT, Convolution of long sequences, Introduction to 2-D DFT</td>
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<td>3.0</td>
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<td>Need of FFT, Radix-2 DIT-FFT algorithm,</td>
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University of Mumbai, B. E. (Computer Engineering), Rev. 2016
<table>
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<th>Hrs.</th>
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<td>DIT-FFT Flow graph for N=4 and 8, Inverse FFT algorithm.</td>
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<td>Spectral Analysis using FFT</td>
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<td>Digital Image Fundamentals</td>
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<td>Introduction to Digital Image, Digital Image Processing System, Sampling and Quantization</td>
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<td>Representation of Digital Image, Connectivity</td>
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<td>Image File Formats: BMP, TIFF and JPEG.</td>
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<td>Image Enhancement in Spatial domain</td>
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<td>Gray Level Transformations, Zero Memory Point Operations,</td>
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<td>Histogram Processing, Histogram equalization.</td>
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<td>Neighborhood Processing, Spatial Filtering, Smoothing and Sharpening Filters, Median Filter.</td>
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<td>6.1</td>
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<td>Segmentation based on Discontinuities (point, Line, Edge).</td>
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**Total**: 52

**Text Books:**


**Reference Books:**


**Assessment:**

**Internal Assessment:**
Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 50% syllabus is completed. Duration of each test shall be one hour.

**End Semester Theory Examination:**
1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.
Course Code | Course Name | Credits  
--- | --- | ---  
CSC702 | Mobile Communication & Computing | 4

**Course objectives:**
1. To introduce the basic concepts and principles in mobile computing. This includes major techniques involved, and networks & systems issues for the design and implementation of mobile computing systems and applications.
2. To explore both theoretical and practical issues of mobile computing.
3. To provide an opportunity for students to understand the key components and technologies involved and to gain hands-on experiences in building mobile applications.

**Course outcomes:** On successful completion of course learner will be able:
1. To identify basic concepts and principles in mobile communication & computing, cellular architecture.
2. To describe the components and functioning of mobile networking.
3. To classify variety of security techniques in mobile network.
4. To apply the concepts of WLAN for local as well as remote applications.
5. To describe and apply the concepts of mobility management
6. To describe Long Term Evolution (LTE) architecture and its interfaces.

**Prerequisite:** Computer Networks

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<th>Unit No.</th>
<th>Topics</th>
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<td>1.2</td>
<td>Electromagnetic Spectrum, Antenna ,Signal Propagation, Signal Characteristics, , Multiplexing, Spread Spectrum: DSSS &amp; FHSS</td>
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<td>3.0</td>
<td>3.1</td>
<td>Mobile Networking : Medium Access Protocol, Internet Protocol and Transport layer</td>
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<td>3.2</td>
<td>Medium Access Control: Motivation for specialized MAC, , Introduction to multiple Access techniques (MACA)</td>
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### 3.3 Mobile IP: IP Packet Delivery, Agent Advertisement and Discovery, Registration, Tunneling and Encapsulation, Reverse Tunneling, Routing (DSDV,DSR)

### 3.4 Mobile TCP: Traditional TCP, Classical TCP Improvements like Indirect TCP, Snooping TCP & Mobile TCP, Fast Retransmit/ Fast Recovery, Transmission/Timeout Freezing, Selective Retransmission

### 4.0 Wireless Local Area Networks: Introduction, Infrastructure and ad-hoc network

#### 4.1 Wireless Local Area Networks: Introduction, Infrastructure and ad-hoc network

#### 4.2 IEEE 802.11: System architecture, Protocol architecture, Physical layer, Medium access control layer, MAC management, 802.11a, 802.11b

#### 4.3 Wi-Fi security: WEP, WPA, Wireless LAN Threats, Securing Wireless Networks

#### 4.4 HiperLAN 1 & HiperLAN 2

#### 4.5 Bluetooth: Introduction, User Scenario, Architecture, protocol stack

### 5.0 Mobility Management: Introduction, IP Mobility, Optimization, IPv6

#### 5.1 Mobility Management: Introduction, IP Mobility, Optimization, IPv6

#### 5.2 Macro Mobility: MIPv6, FMIPv6

#### 5.3 Micro Mobility: CellularIP, HAWAII, HMIPv6

### 6.0 Long-Term Evolution (LTE) of 3GPP: LTE System Overview, Evolution from UMTS to LTE

#### 6.1 Long-Term Evolution (LTE) of 3GPP: LTE System Overview, Evolution from UMTS to LTE

#### 6.2 LTE/SAE Requirements, SAE Architecture

#### 6.3 EPS: Evolved Packet System, E-UTRAN, Voice over LTE (VoLTE), Introduction to LTE-Advanced

#### 6.4 System Aspects, LTE Higher Protocol Layers, LTE MAC layer, LTE PHY Layer

#### 6.5 Self Organizing Network (SON-LTE), SON for Heterogeneous Networks (HetNet), Introduction to 5G

### Assessment:

**Internal Assessment:**
Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.

University of Mumbai, B. E. (Computer Engineering), Rev. 2016
End Semester Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Text Books:
1. Jochen Schiller,"Mobile Communication “, Addison wisely, Pearson Education
3. Raj Kamal, Mobile Computing, 2/e , Oxford University Press-New Delhi

Reference Books:
1. LTE Self-Organizing Networks (SON): Network Management Automation for Operational Efficiency, Seppo Hamalainen, Henning Sanneck, Cinzia Sartori, Wiley publications
Course Code | Course Name | Credits
--- | --- | ---
CSC703 | Artificial Intelligence & Soft Computing | 4

Course Objectives (CO):
1. To conceptualize the basic ideas and techniques of AI and SC.
2. To distinguish various search techniques and to make student understand knowledge representation and planning.
3. To become familiar with basics of Neural Networks and Fuzzy Logic.
4. To familiarize with Hybrid systems and to build expert system.

Course Outcomes: Students should be able to -
1. Identify the various characteristics of Artificial Intelligence and Soft Computing techniques.
2. Choose an appropriate problem solving method for an agent to find a sequence of actions to reach the goal state.
3. Analyse the strength and weakness of AI approaches to knowledge representation, reasoning and planning.
4. Construct supervised and unsupervised ANN for real world applications.
5. Design fuzzy controller system.
6. Apply Hybrid approach for expert system design.

Pre-requisites: Basic Mathematics, Algorithms

<table>
<thead>
<tr>
<th>Module No.</th>
<th>Unit No.</th>
<th>Topics</th>
<th>Hrs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>1.1</td>
<td>Introduction to Artificial Intelligence(AI) and Soft Computing</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>1.2</td>
<td>Intelligent Agents : Agents and Environments, Rationality, Nature of Environment, Structure of Agent, types of Agent</td>
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<tr>
<td></td>
<td>1.3</td>
<td>Soft Computing: Introduction of soft computing, soft computing vs. hard computing, various types of soft computing techniques.</td>
<td></td>
</tr>
<tr>
<td>2.0</td>
<td>2.1</td>
<td>Problem Solving Agent, Formulating Problems, Example Problems</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>2.2</td>
<td>Uninformed Search Methods: Depth Limited Search, Depth First Iterative Deepening (DFID), Informed Search Method: A* Search</td>
<td></td>
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<tr>
<td></td>
<td>2.3</td>
<td>Optimization Problems: Hill climbing Search, Simulated annealing, Genetic algorithm</td>
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<tr>
<td>3.0</td>
<td>3.1</td>
<td>Knowledge based agents</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>3.2</td>
<td>First order logic: syntax and Semantic, Knowledge Engineering in FOL, Inference in FOL: Unification, Forward Chaining, Backward Chaining and Resolution</td>
<td></td>
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<tr>
<td></td>
<td>3.3</td>
<td>Planning Agent, Types of Planning: Partial Order, Hierarchical Order, Conditional Order</td>
<td></td>
</tr>
<tr>
<td>4.0</td>
<td>4.0</td>
<td>Fuzzy Logic</td>
<td>12</td>
</tr>
</tbody>
</table>
### 4.1 Introduction to Fuzzy Set:
- Fuzzy set theory, Fuzzy set versus crisp set, Crisp relation & fuzzy relations, membership functions.
- Fuzzy Logic: Fuzzy Logic basics, Fuzzy Rules and Fuzzy Reasoning
- Fuzzy inference systems: Fuzzification of input variables, defuzzification and fuzzy controllers.

### 5.0 Artificial Neural Network

#### 5.1 Introduction
- Fundamental concept – Basic Models of Artificial Neural Networks – Important Terminologies of ANNs – McCulloch-Pitts Neuron

#### 5.2 Neural Network Architecture:
- Perceptron, Single layer Feed Forward ANN, Multilayer Feed Forward ANN, Activation functions, Supervised Learning: Delta learning rule, Back Propagation algorithm.

#### 5.3 Un-Supervised Learning algorithm: Self Organizing Maps

### 6.0 Expert System

#### 6.1 Hybrid Approach - Fuzzy Neural Systems

### Text Books:

### Reference Books:

### Internal Assessment:
Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.

### End Semester Theory Examination:
1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>CSDLO7031</td>
<td>Advanced System Security and Digital Forensics</td>
<td>4</td>
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</tbody>
</table>

**Course Objectives:**
1. To understand cyber attacks and defence strategies.
2. To understand underlying principles of access control mechanisms.
3. To explore software vulnerabilities, attacks and protection mechanisms of wireless networks and protocols, mobile devices and web applications.
4. To develop and mitigate security management and policies.
5. To understand and explore techniques used in digital forensics.

**Course Outcomes:** At the end of the course learner will able to
1. Understand cyber attacks and apply access control policies and control mechanisms.
2. Identify malicious code and targeted malicious code.
3. Detect and counter threats to web applications.
4. Understand the vulnerabilities of Wi-Fi networks and explore different measures to secure wireless protocols, WLAN and VPN networks.
5. Understand the ethical and legal issues associated with cyber crimes and be able to mitigate impact of crimes with suitable policies.
6. Use different forensic tools to acquire and duplicate data from compromised systems and analyse the same.

**Prerequisite:** Cryptography and System Security

<table>
<thead>
<tr>
<th>Module No.</th>
<th>Unit No.</th>
<th>Detailed Content</th>
<th>Hrs</th>
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</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td><strong>Introduction &amp; Access Control</strong></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>Cyber-attacks, Vulnerabilities, Defence Strategies and Techniques, Authentication Methods and Protocols, Defence in Depth Strategies.</td>
<td>08</td>
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<tr>
<td></td>
<td>1.2</td>
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<td></td>
<td></td>
<td><strong>Program &amp; OS Security</strong></td>
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</tr>
<tr>
<td>2</td>
<td>2.1</td>
<td>Malicious and Non-Malicious programming errors, Targeted Malicious codes: Salami Attack, Linearization Attack, Covert Channel, Control against Program threats.</td>
<td>08</td>
</tr>
<tr>
<td></td>
<td>2.2</td>
<td>Operating System Security: Memory and Address protection, File Protection Mechanism, User Authentication.</td>
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<td><strong>Web Application Security</strong></td>
<td>12</td>
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<td></td>
<td></td>
<td>OWASP, Web Security Considerations, User Authentication and Session</td>
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<tr>
<td>4</td>
<td>Wireless Security</td>
<td>08</td>
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<thead>
<tr>
<th>5</th>
<th>Legal and Ethical issues</th>
<th>06</th>
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</thead>
<tbody>
<tr>
<td>5.1</td>
<td>Cybercrime and its types, Intellectual property, Privacy, Ethical issues.</td>
<td></td>
</tr>
<tr>
<td>5.2</td>
<td>Protecting Programs and Data, Information and the Law, Rights of Employees and Employers, Redress for Software Failures, Computer Crime, Ethical Issues in Computer Security, case studies of ethics.</td>
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</tbody>
</table>

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<tr>
<th>6</th>
<th>Digital Forensics</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Introduction to Digital Forensics, Acquiring Volatile Data from Windows and Unix systems, Forensic Duplication Techniques, Analysis of forensic images using open source tools like Autopsy and SIFT, Investigating logs from Unix and windows systems, Investigating Windows Registry.</td>
<td></td>
</tr>
</tbody>
</table>

**Text Books:**


**Reference Books:**

2. Digital Forensics by Nilakshi Jain & Kalbande, Wiley.

**Digital references:**


**Assessment:**

**Internal Assessment:**

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.
Theory Examination:
1. Question paper will comprise of total six question.
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

=================================================================

Laboratory/ Experimental Work

# The Experiments for this course are required to be performed and to be evaluated in CSL704: Computational Lab-1.

Lab Outcome:
Learner will able to
1. Analyze static code and program vulnerabilities using open source tools.
2. Explore and analyze network vulnerabilities using open source tools.
3. Explore and analyze different security tools to detect web application and browser vulnerabilities.
4. Explore and analyze different tools to secure wireless networks and routers, and mobile devices and perform penetration testing, and analyze its impact.
5. Understand and implement AAA using RADIUS and TACACS.
6. Explore various forensics tools in Kali Linux and use them to acquire, duplicate and analyze data and recover deleted data.

<table>
<thead>
<tr>
<th>Sr. No</th>
<th>Description</th>
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<tbody>
<tr>
<td>1</td>
<td>Static code analysis using open source tools like RATS, Flawfinder etc.</td>
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<tr>
<td>3</td>
<td>Vulnerability scanning using Nessus, Nikto (Kali Linux)</td>
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<tr>
<td>4</td>
<td>Explore web-application vulnerabilities using open source tools like Wapiti, browser exploitation framework (BeEf), etc.</td>
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<tr>
<td>5</td>
<td>Detect SQL injection vulnerabilities in a website database using SQLMap</td>
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<tr>
<td>6</td>
<td>Performing a penetration testing using Metasploit (Kali Linux)</td>
</tr>
<tr>
<td>7</td>
<td>Exploring Router and VLAN security, setting up access lists using Cisco Packet tracer(student edition)</td>
</tr>
<tr>
<td>8</td>
<td>Exploring VPN security using Cisco Packet tracer(student edition)</td>
</tr>
<tr>
<td>9</td>
<td>Exploring Authentication and access control using RADIUS, TACACS and TACACS+</td>
</tr>
<tr>
<td>10</td>
<td>Install and use a security app on an Android mobile (e.g. Droidcrypt)</td>
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<td>11</td>
<td>Explore forensics tools in Kali Linux for acquiring, analyzing and duplicating data: dd, dcflldd, foremost, scalpel, debugfs, wireshark, tcptrace, tcpflow</td>
</tr>
<tr>
<td>12</td>
<td>Analysis of forensic images using open source tools like Autopsy, SIFT, FKT Imager</td>
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<td>13</td>
<td>Use of steganographic tools like OpenStego, to detect data hiding or unauthorized file copying</td>
</tr>
</tbody>
</table>
14. Use Password cracking using tools like John the Ripper/Cain and Abel/ Ophcrack to detect weak passwords.

**Reference Books:**

1. Build your own Security Lab, Michael Gregg, Wiley India
3. Web Application Hacker’s Handbook, Dafydd Stuttard, Marcus Pinto, Wiley India

**Digital References:**

http://www.opentechinfo.com/learn-use-kali-linux/
CSDLO7032  Big Data Analytics  4

Course Objectives:

1. To provide an overview of an exciting growing field of big data analytics.
2. To introduce programming skills to build simple solutions using big data technologies such as MapReduce and scripting for NoSQL, and the ability to write parallel algorithms for multiprocessor execution.
3. To teach the fundamental techniques and principles in achieving big data analytics with scalability and streaming capability.
4. To enable students to have skills that will help them to solve complex real-world problems in for decision support.
5. To provide an indication of the current research approaches that is likely to provide a basis for tomorrow's solutions.

Course Outcomes: Learner will be able to…

1. Understand the key issues in big data management and its associated applications for business decisions and strategy.
2. Develop problem solving and critical thinking skills in fundamental enabling techniques like Hadoop, Mapreduce and NoSQL in big data analytics.
3. Collect, manage, store, query and analyze various forms of Big Data.
4. Interpret business models and scientific computing paradigms, and apply software tools for big data analytics.
5. Adapt adequate perspectives of big data analytics in various applications like recommender systems, social media applications etc.
6. Solve Complex real world problems in various applications like recommender systems, social media applications, health and medical systems, etc.

Prerequisite:
Some prior knowledge about Java programming, Basics of SQL, Data mining and machine learning methods would be beneficial.

<table>
<thead>
<tr>
<th>Module</th>
<th>Detailed Contents</th>
<th>Hrs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td><strong>Introduction to Big Data and Hadoop</strong></td>
<td>06</td>
</tr>
<tr>
<td></td>
<td>1.1 Introduction to Big Data</td>
<td></td>
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<td></td>
<td>1.2 Big Data characteristics, types of Big Data</td>
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<td>1.3 Traditional vs. Big Data business approach</td>
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<td></td>
<td>1.4 Case Study of Big Data Solutions</td>
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<td></td>
<td>1.5 Concept of Hadoop</td>
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<td>1.6 Core Hadoop Components; Hadoop Ecosystem</td>
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<tr>
<td>02</td>
<td><strong>Hadoop HDFS and MapReduce</strong></td>
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<td>2.1 Distributed File Systems: Physical Organization of Compute Nodes, Large-Scale File-System Organization.</td>
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<td></td>
<td>2.2 MapReduce: The Map Tasks, Grouping by Key, The Reduce Tasks, Combiners, Details of MapReduce Execution, Coping With Node Failures.</td>
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<tr>
<td></td>
<td>2.3 Algorithms Using MapReduce: Matrix-Vector Multiplication by MapReduce, Relational-Algebra Operations, Computing Selections by MapReduce, Computing Projections by MapReduce, Union, Intersection, and Difference by MapReduce</td>
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<td>2.4 Hadoop Limitations</td>
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<tr>
<td>03</td>
<td><strong>NoSQL</strong></td>
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<td></td>
<td>3.1 Introduction to NoSQL, NoSQL Business Drivers,</td>
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<td></td>
<td>3.2 NoSQL Data Architecture Patterns: Key-value stores, Graph stores, Column family (Bigtable) stores, Document stores, Variations of NoSQL architectural patterns, NoSQL Case Study</td>
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<td></td>
<td>3.3 NoSQL solution for big data, Understanding the types of big data problems; Analyzing big data with a shared-nothing architecture; Choosing distribution models: master-slave versus peer-to-peer; NoSQL systems to handle big data problems.</td>
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<tr>
<td>04</td>
<td><strong>Mining Data Streams:</strong></td>
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<td>4.2 Sampling Data techniques in a Stream</td>
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<td>4.3 Filtering Streams: Bloom Filter with Analysis.</td>
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<td>4.4 Counting Distinct Elements in a Stream, Count-Distinct Problem, Flajolet-Martin Algorithm, Combining Estimates, Space Requirements</td>
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<td>4.5 Counting Frequent Items in a Stream, Sampling Methods for Streams, Frequent Itemsets in Decaying Windows.</td>
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<td>4.6 Counting Ones in a Window: The Cost of Exact Counts, The Datar-Gionis-Indyk-Motwani Algorithm, Query Answering in the DGIM Algorithm, Decaying Windows.</td>
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<tr>
<td>05</td>
<td><strong>Finding Similar Items and Clustering</strong></td>
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<td></td>
<td>5.1 Distance Measures: Definition of a Distance Measure, Euclidean Distances, Jaccard Distance, Cosine Distance, Edit Distance, Hamming Distance.</td>
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<td>5.2 CURE Algorithm, Stream-Computing, A Stream-Clustering Algorithm, Initializing &amp; Merging Buckets, Answering Queries</td>
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<tr>
<td>06</td>
<td><strong>Real-Time Big Data Models</strong></td>
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<td></td>
<td>6.1 PageRank Overview, Efficient computation of</td>
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</table>
PageRank: PageRank Iteration Using MapReduce, Use of Combiners to Consolidate the Result Vector. 
6.2 A Model for Recommendation Systems, Content-Based Recommendations, Collaborative Filtering. 
6.3 Social Networks as Graphs, Clustering of Social-Network Graphs, Direct Discovery of Communities in a social graph.

Text Books:
1. CreAnand Rajaraman and Jeff Ullman “Mining of Massive Datasets”, Cambridge University Press, 
3. Dan Mcary and Ann Kelly “Making Sense of NoSQL” – A guide for managers and the rest of us, Manning Press.

References books:

Term Work: 
Assign a case study for group of 3/4 students and each group to perform the following experiments on their case-study; Each group should perform the exercises on a large dataset created by them.

The distribution of marks for term work shall be as follows:
- Programming Exercises: .................................................. (10) Marks.
- Mini project: ................................................................. (10) Marks.
- Attendance (Theory & Practical) ........................................... (05) Marks.
TOTAL: ................................................................. (25) Marks.

Internal Assessment:
Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.
End Semester Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining questions (Q.2 to Q.6) will be selected from all the modules.

Oral examination:
An oral exam will be held based on the above syllabus.

Suggested Practical List:
1. Hadoop HDFS Practical:
   -HDFS Basics, Hadoop Ecosystem Tools Overview.
   -Installing Hadoop.
   -Copying File to Hadoop.
   -Copy from Hadoop File system and deleting file.
   -Moving and displaying files in HDFS.
   -Programming exercises on Hadoop.
2. Use of Sqoop tool to transfer data between Hadoop and relational database servers.
   a. Sqoop - Installation.
   b. To execute basic commands of Hadoop eco system component Sqoop.
3. To install and configure MongoDB/ Cassandra/ HBase/ Hypertable to execute NoSQL commands.
4. Experiment on Hadoop Map-Reduce / PySpark:
   2. Implementing simple algorithms in Map-Reduce: Matrix multiplication, Aggregates, Joins, Sorting, Searching, etc.
5. Create Hive Database and Descriptive analytics-basic statistics, visualization using Hive/PIG/R.
6. Write a program to implement word count program using MapReduce.
8. Implementing any one Clustering algorithm (K-Means/CURE) using Map-Reduce.
9. Streaming data analysis – use flume for data capture, HIVE/PYSpark for analysis of twitter data, chat data, weblog analysis etc.
10. Implement PageRank using Map-Reduce.
11. Implement predictive Analytics techniques (regression / time series, etc.) using R/ Scilab/ Tableau/ Rapid miner.
12. Mini Project: One real life large data application to be implemented (Use standard Datasets available on the web).

# The Experiments for this course are required to be performed and to be evaluated
in CSL704: Computational Lab-1.
Course Code | Course Name | Credits
---|---|---
CSDLO7033 | Robotics | 4

Course objectives:
1. To know basics of a typical robot and its characteristics.
2. To analyse mathematically kinematic modelling of a typical robot manipulator.
3. To identify actuators, sensors and control of a robot for different applications.
4. To apply task planning and vision algorithms.

Course outcomes: On successful completion of course learner will be able to:
1. Describe typical robot and its characteristics.
2. Analyse kinematics parameters of robotic manipulator.
3. Identify actuators, sensors and control of a robot for different applications.
4. Design task plan and motion for a robot.
5. Apply Robotics to solve day to day problems using vision algorithms.
6. Use robot programming languages and acquire skills to program robots.

Prerequisite: Mathematical concepts of Geometry, Matrices Algebra, knowledge of Basic Electronics.

<table>
<thead>
<tr>
<th>Module No.</th>
<th>Unit No.</th>
<th>Topics</th>
</tr>
</thead>
</table>
| 1.0 | 1.1 | **Introduction and Fundamentals of Robotics**
Types of automation, Introduction, definition of a Robot, Classification of Robots, Robotics, History of Robotics, Advantages and Disadvantages of Robots, Robot Applications |
| | 1.2 | Tasks involved in Robotics, Robot Components, Robot characteristics and classification, Degrees of Freedom, Robot joints, Robot Coordinates, Robot Reference frames, Programming Modes, Robot Workspace, Work Envelop. |
| 2.0 | 2.1 | **Direct (Forward) Kinematics**: Homogeneous coordinates, Link coordinates, Coordinate frame, coordinate transform, Arm equations, An example – Four Axis SCARA. |
| | 2.2 | **Inverse Kinematics**: Inverse kinematics problem, Tool Configuration, An example – Four Axis SCARA. |
| | | **Sensors, Actuators and Drive Systems** |

Hrs. 08 08 08
| 3.0 | 3.1 | **Sensors**: Characteristics, Utilization, Types - Position, Velocity, Acceleration, Force and Pressure, Torque, Visible Light and Infrared, Touch and Tactile, Proximity, Range Finders sensors. |
| 3.2 | **Actuators and Drive System**: Characteristics, Hydraulic Actuators, Pneumatic Devices, Electric Motors |
| 4.0 | **Robot Task and Motion Planning** |
| 4.1 | Reactive Paradigms: Overview, Attributes of reactive paradigm |
| 4.2 | Task level programming, Uncertainty, Configuration Space, Gross motion planning, Fine-motion planning, Simulation of Planner motion, Source and goal scene, Task planner Simulation. |
| 4.3 | Robot Motion Planning: Concept of motion planning, BUG 1, BUG 2 and Tangent Bug Algorithms |
| 5.0 | **Robot Vision** |
| 5.1 | Image Representation, Template Matching, Polyhedral Objects |
| 5.2 | Shape Analysis, Iterative Processing |
| 5.3 | Perspective Transformations, Structured Illumination, Camera Calibration |
| 6.0 | **Expert Systems, Robot Language and Fuzzy Logic** |
| **Total** | 52 |

**Text Books:**
3. Introduction to AI robotics by Robin Murphy, PHI.

University of Mumbai, B. E. (Computer Engineering), Rev. 2016
4. Robotics Technology and Flexible Automation by S. R. Deb, TMH.
5. Artificial Intelligence by Rich, Knight and Nair, TMH.
6. Introduction to Fuzzy Sets by M Ganesh PHI

**Reference Books:**
1. Robotics – Control, Sensing, Vision, and Intelligence by K. S. Fu, R. C. Gonzalez, C. S. G.
   Lee, Tata McGraw Hill
2. Principles of Robot Motion – Theory, Algorithms and Implementation by Howie Choset, Lynch, PHI

**Assessment:**

**Internal Assessment:**
Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.

**End Semester Theory Examination:**
1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

**Term Work :**
The distribution of marks for term work shall be as follows:
• Programming Exercises: .......................................................... (10) Marks.
• Mini project: ............................................................................. (10) Marks.
• Attendance (Theory & Practical) .................................................. (05) Marks.
**TOTAL:** .................................................................................... (25) Marks.

**Suggested List of Experiments:**
1. Representation of Various Robots and there all Specification (Study Experiment)
2. Co-ordinate Transform of a Robot
3. Fundamental Rotation
4. Composite Rotation
5. BFS and DFS
6. Homogeneous Rotation
7. Run Length Encoding
8. Shrink and swell Operator
9. BUG1 Algorithm
10 Bug2 Algorithm
11 Tangent Bug Algorithm
12 Edge detection algorithm
13 Case Study of CNC Machine
14 Designing a Robot Manipulator for Pre defined Task

Students can perform experiments based on Theory Syllabus or any 12 experiments from above list of experiments or experiments framed by teachers.

# The Experiments for this course are required to be performed and to be evaluated in CSL704: Computational Lab-1.
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<tr>
<th>Sr. No.</th>
<th>Detailed Contents</th>
<th>Hrs</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td><strong>Introduction to Product Lifecycle Management (PLM):</strong> Product Lifecycle Management (PLM), Need for PLM, Product Lifecycle Phases, Opportunities of Globalization, Pre-PLM Environment, PLM Paradigm, Importance &amp; Benefits of PLM, Widespread Impact of PLM, Focus and Application, A PLM Project, Starting the PLM Initiative, PLM Applications</td>
<td>10</td>
</tr>
<tr>
<td>02</td>
<td><strong>PLM Strategies:</strong> Industrial strategies, Strategy elements, its identification, selection and implementation, Developing PLM Vision and PLM Strategy, Change management for PLM</td>
<td></td>
</tr>
<tr>
<td>04</td>
<td><strong>Product Data Management (PDM):</strong> Product and Product Data, PDM systems and importance, Components of PDM, Reason for implementing a PDM system, financial justification of PDM, barriers to PDM implementation</td>
<td></td>
</tr>
<tr>
<td>05</td>
<td><strong>Virtual Product Development Tools:</strong> For components, machines, and manufacturing plants, 3D CAD systems and realistic rendering techniques, Digital mock-up, Model building, Model analysis, Modeling and simulations in Product Design, Examples/Case studies</td>
<td>05</td>
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<tr>
<td>06</td>
<td><strong>Integration of Environmental Aspects in Product Design:</strong> Sustainable Development,</td>
<td>05</td>
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**Assessment:**

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4. Only **Four questions need to be solved.**

**REFERENCES:**

Objectives:
1. To familiarize the students with various aspects of probability theory
2. To acquaint the students with reliability and its concepts
3. To introduce the students to methods of estimating the system reliability of simple and complex systems
4. To understand the various aspects of Maintainability, Availability and FMEA procedure

Outcomes: Learner will be able to…
1. Understand and apply the concept of Probability to engineering problems
2. Apply various reliability concepts to calculate different reliability parameters
3. Estimate the system reliability of simple and complex systems
4. Carry out a Failure Mode Effect and Criticality Analysis

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<th>Sr. No</th>
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<tbody>
<tr>
<td>01</td>
<td>Probability theory: Probability: Standard definitions and concepts; Conditional Probability, Baye’s Theorem. Probability Distributions: Central tendency and Dispersion; Binomial, Normal, Poisson, Weibull, Exponential, relations between them and their significance. Measures of Dispersion: Mean, Median, Mode, Range, Mean Deviation, Standard Deviation, Variance, Skewness and Kurtosis.</td>
<td>08</td>
</tr>
<tr>
<td>02</td>
<td>Reliability Concepts: Reliability definitions, Importance of Reliability, Quality Assurance and Reliability, Bath Tub Curve. Failure Data Analysis: Hazard rate, failure density, Failure Rate, Mean Time To Failure (MTTF), MTBF, Reliability Functions. Reliability Hazard Models: Constant Failure Rate, Linearly increasing, Time Dependent Failure Rate, Weibull Model, Distribution functions and reliability analysis.</td>
<td>08</td>
</tr>
<tr>
<td>03</td>
<td>System Reliability: System Configurations: Series, parallel, mixed configuration, k out of n structure, Complex systems.</td>
<td>05</td>
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<tr>
<td>05</td>
<td>Maintainability and Availability: System downtime, Design for Maintainability: Maintenance requirements, Design methods: Fault Isolation and self-diagnostics, Parts standardization and Interchangeability, Modularization and Accessibility, Repair Vs Replacement. Availability – qualitative aspects.</td>
<td>05</td>
</tr>
<tr>
<td>06</td>
<td>Failure Mode, Effects and Criticality Analysis: Failure mode effects analysis, severity/criticality analysis, FMECA examples. Fault tree construction, basic symbols, development of functional reliability block diagram, Fault tree analysis and Event tree Analysis</td>
<td>05</td>
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4. Only Four questions need to be solved.

REFERENCES:

Course Code | Course Name | Credits
---|---|---
ILO 7013 | Management Information System | 03

**Objectives:**
1. The course is blend of Management and Technical field.
2. Discuss the roles played by information technology in today’s business and define various technology architectures on which information systems are built
3. Define and analyze typical functional information systems and identify how they meet the needs of the firm to deliver efficiency and competitive advantage
4. Identify the basic steps in systems development

**Outcomes:** Learner will be able to…
1. Explain how information systems Transform Business
2. Identify the impact information systems have on an organization
3. Describe IT infrastructure and its components and its current trends
4. Understand the principal tools and technologies for accessing information from databases to improve business performance and decision making
5. Identify the types of systems used for enterprise-wide knowledge management and how they provide value for businesses

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<td>01</td>
<td>Introduction To Information Systems (IS): Computer Based Information Systems, Impact of IT on organizations, Importance of IS to Society. Organizational Strategy, Competitive Advantages and IS</td>
<td>4</td>
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<tr>
<td>02</td>
<td>Data and Knowledge Management: Database Approach, Big Data, Data warehouse and Data Marts, Knowledge Management Business intelligence (BI): Managers and Decision Making, BI for Data analysis and Presenting Results</td>
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<tr>
<td>03</td>
<td>Ethical issues and Privacy: Information Security. Threat to IS, and Security Controls</td>
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<tr>
<td>05</td>
<td>Computer Networks Wired and Wireless technology, Pervasive computing, Cloud computing model.</td>
<td>6</td>
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**REFERENCES:**

1. Kelly Rainer, Brad Prince, Management Information Systems, Wiley
**Course Code**  | **Course Name**          | **Credits** |
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<td>ILO 7014</td>
<td>Design of Experiments</td>
<td>03</td>
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**Objectives:**
1. To understand the issues and principles of Design of Experiments (DOE)
2. To list the guidelines for designing experiments
3. To become familiar with methodologies that can be used in conjunction with experimental designs for robustness and optimization

**Outcomes:** Learner will be able to…
1. Plan data collection, to turn data into information and to make decisions that lead to appropriate action
2. Apply the methods taught to real life situations
3. Plan, analyze, and interpret the results of experiments

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<tr>
<td>01</td>
<td><strong>Introduction</strong>&lt;br&gt;1.1 Strategy of Experimentation&lt;br&gt;1.2 Typical Applications of Experimental Design&lt;br&gt;1.3 Guidelines for Designing Experiments&lt;br&gt;1.4 Response Surface Methodology</td>
<td>06</td>
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<tr>
<td>02</td>
<td><strong>Fitting Regression Models</strong>&lt;br&gt;2.1 Linear Regression Models&lt;br&gt;2.2 Estimation of the Parameters in Linear Regression Models&lt;br&gt;2.3 Hypothesis Testing in Multiple Regression&lt;br&gt;2.4 Confidence Intervals in Multiple Regression&lt;br&gt;2.5 Prediction of new response observation&lt;br&gt;2.6 Regression model diagnostics&lt;br&gt;2.7 Testing for lack of fit</td>
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<tr>
<td>03</td>
<td><strong>Two-Level Factorial Designs</strong>&lt;br&gt;3.1 The 2² Design&lt;br&gt;3.2 The 2³ Design&lt;br&gt;3.3 The General2ᵏ Design&lt;br&gt;3.4 A Single Replicate of the 2ᵏ Design&lt;br&gt;3.5 The Addition of Center Points to the 2ᵏ Design,&lt;br&gt;3.6 Blocking in the 2ᵏ Factorial Design&lt;br&gt;3.7 Split-Plot Designs</td>
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<td>04</td>
<td><strong>Two-Level Fractional Factorial Designs</strong>&lt;br&gt;4.1 The One-Half Fraction of the 2ᵏ Design&lt;br&gt;4.2 The One-Quarter Fraction of the 2ᵏ Design&lt;br&gt;4.3 The General 2ᵏ-p Fractional Factorial Design&lt;br&gt;4.4 Resolution III Designs&lt;br&gt;4.5 Resolution IV and V Designs&lt;br&gt;4.6 Fractional Factorial Split-Plot Designs</td>
<td>07</td>
</tr>
<tr>
<td>05</td>
<td><strong>Response Surface Methods and Designs</strong>&lt;br&gt;5.1 Introduction to Response Surface Methodology</td>
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</tbody>
</table>
5.2 The Method of Steepest Ascent
5.3 Analysis of a Second-Order Response Surface
5.4 Experimental Designs for Fitting Response Surfaces

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<th>06</th>
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<td>6.1 Crossed Array Designs and Signal-to-Noise Ratios</td>
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<td></td>
<td>6.2 Analysis Methods</td>
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<td></td>
<td>6.3 Robust design examples</td>
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4. Only Four questions need to be solved.

REFERENCES:
5. Design and Analysis of Experiments (Springer text in Statistics), Springer by A.M. Dean, and D. T.Voss
Objectives:
1. Formulate a real-world problem as a mathematical programming model.
2. Understand the mathematical tools that are needed to solve optimization problems.
3. Use mathematical software to solve the proposed models.

Outcomes: Learner will be able to...
1. Understand the theoretical workings of the simplex method, the relationship between a linear program and its dual, including strong duality and complementary slackness.
2. Perform sensitivity analysis to determine the direction and magnitude of change of a model’s optimal solution as the data change.
3. Solve specialized linear programming problems like the transportation and assignment problems, solve network models like the shortest path, minimum spanning tree, and maximum flow problems.
4. Understand the applications of integer programming and a queuing model and compute important performance measures

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<td>01</td>
<td><strong>Introduction to Operations Research</strong>: Introduction, Limitations of Operations Research</td>
<td></td>
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<td></td>
<td><strong>Linear Programming</strong>: Introduction, Linear Programming Problem, Requirements of LPP, Mathematical Formulation of LPP, Graphical method, Simplex Method Penalty Cost Method or Big M-method, Two Phase Method, Revised simplex method, <strong>Duality</strong>, Primal – Dual construction, Symmetric and Asymmetric Dual, Weak Duality Theorem, Complimentary Slackness Theorem, Main Duality Theorem, Dual Simplex Method, Sensitivity Analysis <strong>Transportation Problem</strong>: Formulation, solution, unbalanced Transportation problem. Finding basic feasible solutions – Northwest corner rule, least cost method and Vogel’s approximation method. Optimality test: the stepping stone method and MODI method. <strong>Assignment Problem</strong>: Introduction, Mathematical Formulation of the Problem, Hungarian Method Algorithm, Processing of n Jobs Through Two Machines and m Machines, Graphical Method of Two Jobs m Machines Problem Routing Problem, Travelling Salesman Problem <strong>Integer Programming Problem</strong>: Introduction, Types of Integer Programming Problems, Gomory’s cutting plane Algorithm, Branch and Bound Technique. Introduction to Decomposition algorithms.</td>
<td>14</td>
</tr>
<tr>
<td>02</td>
<td><strong>Queuing models</strong>: queuing systems and structures, single server and multi-server models, Poisson input, exponential service, constant rate service, finite and infinite population</td>
<td>05</td>
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<td>03</td>
<td><strong>Simulation</strong>: Introduction, Methodology of Simulation, Basic Concepts, Simulation Procedure, Application of Simulation Monte-Carlo Method: Introduction, Monte-Carlo Simulation, Applications of Simulation, Advantages of Simulation, Limitations of Simulation</td>
<td>05</td>
</tr>
<tr>
<td>04</td>
<td><strong>Dynamic programming.</strong> Characteristics of dynamic programming. Dynamic programming approach for Priority Management employment smoothing, capital budgeting, Stage Coach/Shortest Path, cargo loading and Reliability problems.</td>
<td>05</td>
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<tr>
<td>05</td>
<td><strong>Game Theory.</strong> Competitive games, rectangular game, saddle point, minimax (maximin) method of optimal strategies, value of the game. Solution of games with saddle points, dominance principle. Rectangular games without saddle point – mixed strategy for 2 X 2 games.</td>
<td>05</td>
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<tr>
<td>06</td>
<td><strong>Inventory Models:</strong> Classical EOQ Models, EOQ Model with Price Breaks, EOQ with Shortage, Probabilistic EOQ Model,</td>
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4. Only **Four questions need to be solved.**

**REFERENCES:**

5. Operations Research, KantiSwarup, P. K. Gupta and Man Mohan, Sultan Chand & Sons
**Course Code**: ILO 7016  
**Course Name**: Cyber Security and Laws  
**Credits**: 03

**Objectives:**
1. To understand and identify different types cybercrime and cyber law
2. To recognized Indian IT Act 2008 and its latest amendments
3. To learn various types of security standards compliances

**Outcomes:** Learner will be able to…
1. Understand the concept of cybercrime and its effect on outside world
2. Interpret and apply IT law in various legal issues
3. Distinguish different aspects of cyber law
4. Apply Information Security Standards compliance during software design and development

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<tr>
<td>01</td>
<td><strong>Introduction to Cybercrime</strong>: Cybercrime definition and origins of the world, Cybercrime and information security, Classifications of cybercrime, Cybercrime and the Indian ITA 2000, A global Perspective on cybercrimes.</td>
<td>4</td>
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</tbody>
</table>
| 03      | **Tools and Methods Used in Cyberline**  
Phishing, Password Cracking, Key loggers and Spywares, Virus and Worms, Steganography, DoS and DDoS Attacks, SQL Injection, Buffer Over Flow, Attacks on Wireless Networks, Phishing, Identity Theft (ID Theft) | 6   |
| 04      | **The Concept of Cyberspace**  
| 05      | **Indian IT Act**.  
| 06      | **Information Security Standard compliances**  
SOX, GLBA, HIPAA, ISO, FISMA, NERC, PCI. | 6   |
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REFERENCES:

1. Nina Godbole, Sunit Belapure, Cyber Security, Wiley India, New Delhi
2. The Indian Cyber Law by Suresh T. Vishwanathan; Bharat Law House New Delhi
3. The Information technology Act, 2000; Bare Act- Professional Book Publishers, New Delhi.
4. Cyber Law & Cyber Crimes By Advocate Prashant Mali; Snow White Publications, Mumbai
5. Nina Godbole, Information Systems Security, Wiley India, New Delhi
8. Websites for more information is available on : The Information Technology ACT, 2008- TIFR : https://www.tifrh.res.in
9. Website for more information , A Compliance Primer for IT professional : https://www.sans.org/reading-room/whitepapers/compliance/compliance-primer-professionals-33538
## Course Code: ILO 7017
### Course Name: Disaster Management and Mitigation Measures
### Credits: 03

**Objectives:**

1. To understand physics and various types of disaster occurring around the world
2. To identify extent and damaging capacity of a disaster
3. To study and understand the means of losses and methods to overcome /minimize it.
4. To understand role of individual and various organization during and after disaster
5. To understand application of GIS in the field of disaster management
6. To understand the emergency government response structures before, during and after disaster

**Outcomes: Learner will be able to…**

1. Get to know natural as well as manmade disaster and their extent and possible effects on the economy.
2. Plan of national importance structures based upon the previous history.
3. Get acquainted with government policies, acts and various organizational structure associated with an emergency.
4. Get to know the simple do’s and don’ts in such extreme events and act accordingly.

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<td>01</td>
<td>Introduction</td>
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<tr>
<td></td>
<td>1.1 Definition of Disaster, hazard, global and Indian scenario, general perspective, importance of study in human life, Direct and indirect effects of disasters, long term effects of disasters. Introduction to global warming and climate change.</td>
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<tr>
<td>02</td>
<td>Natural Disaster and Manmade disasters:</td>
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<tr>
<td></td>
<td>2.1 Natural Disaster: Meaning and nature of natural disaster, Flood, Flash flood, drought, cloud burst, Earthquake, Landslides, Avalanches, Volcanic eruptions, Mudflow, Cyclone, Storm, Storm Surge, climate change, global warming, sea level rise, ozone depletion</td>
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<td></td>
<td>2.2 Manmade Disasters: Chemical, Industrial, Nuclear and Fire Hazards. Role of growing population and subsequent industrialization, urbanization and changing lifestyle of human beings in frequent occurrences of manmade disasters.</td>
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<tr>
<td>03</td>
<td>Disaster Management, Policy and Administration</td>
<td>06</td>
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<tr>
<td></td>
<td>3.1 Disaster management: meaning, concept, importance, objective of disaster management policy, disaster risks in India, Paradigm shift in disaster management.</td>
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<tr>
<td></td>
<td>3.2 Policy and administration: Importance and principles of disaster management policies, command and coordination of in disaster management, rescue operations-how to start with and how to proceed in due course of time, study of flowchart showing the entire process.</td>
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<tr>
<td>04</td>
<td>Institutional Framework for Disaster Management in India:</td>
<td>06</td>
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<td></td>
<td>4.1 Importance of public awareness, Preparation and execution of emergency management program. Scope and responsibilities of National Institute of Disaster Management (NIDM) and National disaster management authority (NDMA) in India. Methods and measures to avoid disasters, Management of casualties, set up of emergency facilities, importance of effective communication amongst different agencies in such situations.</td>
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<td></td>
<td>4.2 Use of Internet and softwares for effective disaster management. Applications of GIS, Remote sensing and GPS in this regard.</td>
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<td>05</td>
<td>Financing Relief Measures:</td>
<td>09</td>
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University of Mumbai, B. E. (Computer Engineering), Rev. 2016
5.1 Ways to raise finance for relief expenditure, role of government agencies and NGO’s in this process, Legal aspects related to finance raising as well as overall management of disasters. Various NGO’s and the works they have carried out in the past on the occurrence of various disasters, Ways to approach these teams.

5.2 International relief aid agencies and their role in extreme events.

6. Preventive and Mitigation Measures:
   6.1 Pre-disaster, during disaster and post-disaster measures in some events in general
   6.2 Structural mapping: Risk mapping, assessment and analysis, sea walls and embankments, Bio shield, shelters, early warning and communication
   6.3 Non Structural Mitigation: Community based disaster preparedness, risk transfer and risk financing, capacity development and training, awareness and education, contingency plans.
   6.4 Do’s and don’ts in case of disasters and effective implementation of relief aids.

Assessment:

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   4. Only Four questions need to be solved.

REFERENCES:

5. ‘Disaster management & rehabilitation’ by Rajdeep Dasgupta, Mittal Publications, New Delhi.
6. ‘Natural Hazards  and Disaster Management, Vulnerability and Mitigation – R B Singh, Rawat Publications

(Learners are expected to refer reports published at national and International level and updated information available on authentic web sites)
Objective:
1. To understand the importance energy security for sustainable development and the fundamentals of energy conservation.
2. To introduce performance evaluation criteria of various electrical and thermal installations to facilitate the energy management.
3. To relate the data collected during performance evaluation of systems for identification of energy saving opportunities.

Outcomes: Learner will be able to...
1. To identify and describe present state of energy security and its importance.
2. To identify and describe the basic principles and methodologies adopted in energy audit of an utility.
3. To describe the energy performance evaluation of some common electrical installations and identify the energy saving opportunities.
4. To describe the energy performance evaluation of some common thermal installations and identify the energy saving opportunities.
5. To analyze the data collected during performance evaluation and recommend energy saving measures.

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<tr>
<td>02</td>
<td>Energy Audit Principles: Definition, Energy audit- need, Types of energy audit, Energy management (audit) approach-understanding energy costs, Bench marking, Energy performance, Matching energy use to requirement, Maximizing system efficiencies, Optimizing the input energy requirements, Fuel and energy substitution. Elements of monitoring &amp; targeting; Energy audit Instruments; Data and information-analysis. Financial analysis techniques: Simple payback period, NPV, Return on investment (ROI), Internal rate of return (IRR)</td>
<td>08</td>
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</tbody>
</table>

University of Mumbai, B. E. (Computer Engineering), Rev. 2016
factors affecting Refrigeration and Air Conditioning system performance and savings opportunities.

| 05 | **Energy Performance Assessment:**  
On site Performance evaluation techniques, Case studies based on: Motors and variable speed drive, pumps, HVAC system calculations; Lighting System: Installed Load Efficacy Ratio (ILER) method, Financial Analysis. |
| 06 | **Energy conservation in Buildings:**  
Energy Conservation Building Codes (ECBC); Green Building, LEED rating, Application of Non-Conventional and Renewable Energy Sources |

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**REFERENCES:**

1. Handbook of Electrical Installation Practice, Geofry Stokes, Blackwell Science  
2. Designing with light: Lighting Handbook, By Anil Valia, Lighting System  
8. www.energymanagertraining.com  
9. www.bee-india.nic.in
Objectives:
1. To understand the characteristics of rural Society and the Scope, Nature and Constraints of rural Development.
2. To study Implications of 73rd CAA on Planning, Development and Governance of Rural Areas.
3. An exploration of human values, which go into making a ‘good’ human being, a ‘good’ professional, a ‘good’ society and a ‘good life’ in the context of work life and the personal life of modern Indian professionals.
4. To understand the Nature and Type of Human Values relevant to Planning Institutions.

Outcomes: Learner will be able to…
1. Apply knowledge for Rural Development.
2. Apply knowledge for Management Issues.
3. Apply knowledge for Initiatives and Strategies.
4. Develop acumen for higher education and research.
5. Master the art of working in group of different nature.
6. Develop confidence to take up rural project activities independently.

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Module Contents</th>
<th>Hrs</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>Introduction to Rural Development Meaning, nature and scope of development; Nature of rural society in India; Hierarchy of settlements; Social, economic and ecological constraints for rural development Roots of Rural Development in India Rural reconstruction and Sarvodaya programme before independence; Impact of voluntary effort and Sarvodaya Movement on rural development; Constitutional direction, directive principles; Panchayati Raj - beginning of planning and community development; National extension services.</td>
<td>08</td>
</tr>
<tr>
<td>02</td>
<td>Post-Independence rural Development Balwant Rai Mehta Committee - three tier system of rural local Government; Need and scope for people’s participation and Panchayati Raj; Ashok Mehta Committee - linkage between Panchayati Raj, participation and rural development</td>
<td>04</td>
</tr>
<tr>
<td>03</td>
<td>Rural Development Initiatives in Five Year Plans Five Year Plans and Rural Development; Planning process at National, State, Regional and District levels; Planning, development, implementing and monitoring organizations and agencies; Urban and rural interface - integrated approach and local plans; Development initiatives and their convergence; Special component plan and sub-plan for the weaker section; Micro-eco zones; Data base for local planning; Need for decentralized planning; Sustainable rural development.</td>
<td>06</td>
</tr>
<tr>
<td>04</td>
<td>Post 73rd Amendment Scenario 73rd Constitution Amendment Act, including - XI schedule, devolution of powers, functions and finance; Panchayati Raj institutions - organizational linkages; Recent changes in rural local planning; Gram Sabha - revitalized Panchayati Raj; Institutionalization; resource mapping, resource mobilization including social mobilization; Information Technology and rural planning; Need for further amendments.</td>
<td>04</td>
</tr>
<tr>
<td>05</td>
<td>Values and Science and Technology Material development and its values; the challenge of science and technology; Values in planning profession, research and education.</td>
<td>10</td>
</tr>
</tbody>
</table>
Types of Values  
Psychological values — integrated personality; mental health;  
Societal values — the modern search for a good society; justice, democracy,  
rule of law, values in the Indian constitution;  
Aesthetic values — perception and enjoyment of beauty; Moral and ethical  
values; nature of moral judgment; Spiritual values; different concepts; secular  
spirituality; Relative and absolute values;  
Human values— humanism and human values; human rights; human values as  
freedom, creativity, love and wisdom.

| 06 | Ethics Canons of ethics; ethics of virtue; ethics of duty; ethics of responsibility; Work ethics; Professional ethics; Ethics in planning profession, research and education | 04 |

Assessment:

Internal Assessment for 20 marks:
Consisting Two Compulsory Class Tests
First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:
Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total six questions, each carrying 20 marks
2. Question 1 will be compulsory and should cover maximum contents of the curriculum
3. Remaining questions will be mixed in nature (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four questions need to be solved

References:
1. ITPI, Village Planning and Rural Development, ITPI, New Delhi
3. GoI, Constitution (73rd GoI, New Delhi Amendment) Act, GoI, New Delhi
4. Planning Commission, Five Year Plans, Planning Commission
6. Planning Guide to Beginners
7. Weaver, R.C., The Urban Complex, Doubleday.
Lab Code | Lab Name                        | Credits
---------|--------------------------------|--------
CSL701   | Digital Signal and Image     | 1      
          Processing Lab                      |

**Lab Outcome:** The learner will be able to
1. Sample and reconstruct the signal.
2. Implement and apply operations like Convolution, Correlation, DFT and FFT on DT signals
3. Implement spatial domain Image enhancement techniques.
4. Implement Edge detection techniques using first order derivative filters.

**Description:**
Implementation of programs can be in C or C++ or any computational software. A List of ten experiments is given below, are needed to be performed covering all syllabus modules. Additional experiments within the scope of the syllabus can be added.

**Suggested List of Experiments:**
1. Sampling and Reconstruction
2. To perform Discrete Correlation
3. To perform Discrete Convolution
4. To perform Discrete Fourier Transform
5. To perform Fast Fourier Transform
6. Implementation of Image negative, Gray level Slicing and Thresholding
7. Implementation of Contrast Stretching, Dynamic range compression & Bit plane Slicing
8. Implementation of Histogram Processing
9. Implementation of Image smoothing/Image sharpening
10. Implementation of Edge detection using Sobel and Previtt masks

**Term Work:**
- Laboratory work will be based on above syllabus of CSC701 - ‘Digital Signal and Image Processing’ with minimum 10 experiments to be incorporated.
- The distribution of marks for term work shall be as follows:
  - Lab Performance: 15 Marks
  - Assignments: 05 Marks
  - Attendance (Theory & practical): 05 Marks
Lab Outcome:
1. To develop and demonstrate mobile applications using various tools
2. Students will articulate the knowledge of GSM, CDMA & Bluetooth technologies and demonstrate it.
3. Students will be able to carry out simulation of frequency reuse, hidden terminal problem
4. To develop security algorithms for mobile communication network
5. To demonstrate simulation and compare the performance of Wireless LAN
6. To implement and demonstrate mobile node discovery and route maintains.

Description: The softwares like Android Studio, J2ME, NS2, NS3 and any other software which is suitable are recommended for performing the practicals.

Suggested List of Experiments:

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Title of Experiments</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>To understand the cellular frequency reuse concept to find the co-channel cells for a particular cell. Design a game based application on the above concept.</td>
</tr>
<tr>
<td>02</td>
<td>To understand the cellular frequency reuse concept to find the cell clusters within a certain geographic area. Design a game based application on the above concept.</td>
</tr>
<tr>
<td>03</td>
<td>Implementation of a Bluetooth network with application as transfer of a file from one device to another.</td>
</tr>
<tr>
<td>04</td>
<td>To implement a basic function of Code Division Multiple Access (CDMA) to test the orthogonality and autocorrelation of a code to be used for CDMA operation. Write an application based on the above concept.</td>
</tr>
<tr>
<td>05</td>
<td>To implement Mobile node discovery</td>
</tr>
<tr>
<td>06</td>
<td>Implementation of GSM security algorithms (A3/A5/A8)</td>
</tr>
<tr>
<td>07</td>
<td>Illustration of Hidden Terminal Problem (NS-2) Consider two Wi-Fi base stations (STA) and an access point (AP) located along the x-axis. All the nodes are fixed. The AP is situated at the middle of the two STA, the distance of separation being 150 m. [variable]. Node #0 and node #1 are the hidden terminals. Both are transmitting some data to the AP (almost at same rate) at the same time. The loss across the wireless link between each STA and the AP is fixed at 50 dB irrespective of the distance of separation. To study how RTS/CTS helps in wireless networks, 1. No RTS/CTS is being sent. 2. Nodes do exchange RTS/CTS packets. Compare the no. of packet retransmissions required in both the cases (as obtained in the output) and compare the results.</td>
</tr>
<tr>
<td>08</td>
<td>To setup &amp; configuration of Wireless Access Point (AP) using NS3. Analyze the Wi-Fi communication range in the presence of the access point (AP) and the base station (BS). Consider BS and AP are static. Find out the maximum distance to which two way communications is possible. Try multiple iterations by adjusting its distance in the code and test it.</td>
</tr>
<tr>
<td>09</td>
<td>Develop an application that writes data to the SD card.</td>
</tr>
<tr>
<td>10</td>
<td>Develop an application that uses GUI components.</td>
</tr>
<tr>
<td>11</td>
<td>Write an application that draws basic graphical primitives on the screen.</td>
</tr>
<tr>
<td>12</td>
<td>Develop an application that makes use of database.</td>
</tr>
<tr>
<td>13</td>
<td>Develop a native application that uses GPS location information.</td>
</tr>
<tr>
<td>14</td>
<td>Implement an application that creates an alert upon receiving a message.</td>
</tr>
<tr>
<td>15</td>
<td>Implementation of income tax/loan EMI calculator and deploy the same on real devices.</td>
</tr>
</tbody>
</table>

**Digital Material (if Any):**

3. [https://www.nsnam.org/](https://www.nsnam.org/) : Ns-3 Software Download
4. [http://vlssit.iitkgp.ernet.in/ant/ant/](http://vlssit.iitkgp.ernet.in/ant/ant/)

**Text Books:**


**Term Work:**
Laboratory work will be based on above syllabus with minimum 10 experiments to be incorporated.

Laboratory work (experiments): ………………… (15) Marks.  
Assignments: ………………………………………… (05) Marks.  
Attendance (Theory + Practical): …………………… (05) Marks.  
**TOTAL:** ………………………………………….. (25) Marks.

**Oral & Practical exam** will be based on the above and CSC702: Mobile Communication & Computing syllabus.
Lab Outcomes: Learner will be able to

1. To realize the basic techniques to build intelligent systems
2. To create knowledge base and apply appropriate search techniques used in problem solving.
3. Apply the supervised/unsupervised learning algorithm.
4. Design fuzzy controller system.

Description: The current applications from almost all domains, like games, robots, expert system, optimization or even the search engines are becoming smarter. We have moved to the era of knowledge processing from data and information processing. Therefore learning these technologies practically is very essential for a student to gain the proficiency. They will also learn and be able to appreciate the use of fusion of basic techniques.

<table>
<thead>
<tr>
<th>LAB</th>
<th>Topic / Activity</th>
<th>Explanation of Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lab 1</td>
<td>Identify the problem</td>
<td>Select a problem statement relevant to AI</td>
</tr>
<tr>
<td></td>
<td>PEAS Description</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Problem formulation</td>
<td></td>
</tr>
<tr>
<td>Lab 2</td>
<td>Introduce AI programming Language</td>
<td>Introduce PROLOG programming.</td>
</tr>
<tr>
<td>Lab 3</td>
<td>Start Implementation</td>
<td>Use AI programming languages</td>
</tr>
<tr>
<td></td>
<td>Knowledge Representation and Create Knowledge Base</td>
<td>Or C/JAVA</td>
</tr>
<tr>
<td>Lab 4</td>
<td>Implement search algorithms to reach goal state</td>
<td>Identify and analyse Algorithm to solve the problem</td>
</tr>
<tr>
<td>Lab 5</td>
<td>To implement Mc-Culloch Pitts Model for a problem</td>
<td>Apply to solve AND / OR/ XOR, etc.</td>
</tr>
<tr>
<td>Lab 6</td>
<td>To implement Fuzzy Controller system</td>
<td>Design an automobile or washing machine controller, etc. and implement</td>
</tr>
<tr>
<td>Lab 7</td>
<td>To implement Basic Supervised / Unsupervised Neural Network learning rules for a problem.</td>
<td>Design a NN using a learning method to generate knowledge for classification.</td>
</tr>
<tr>
<td>Lab 8</td>
<td>Case study on Hybrid Systems</td>
<td>Study the designing of Neuro Fuzzy systems</td>
</tr>
<tr>
<td>Lab 9</td>
<td>Case study of an Application</td>
<td>Printed Character Recognition, Face Recognition, etc.</td>
</tr>
</tbody>
</table>
Term Work:

1. Labs 1-4 are to design and implement an intelligent system using AI techniques.
2. Labs 5-7 are to design and implement an Intelligent System using SC techniques.
3. Perform any one from Lab 8 and lab 9.

The distribution of marks for term work shall be as follows:

<table>
<thead>
<tr>
<th>Component</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lab Performance (Experiments /case studies)</td>
<td>15</td>
</tr>
<tr>
<td>Assignment</td>
<td>05</td>
</tr>
<tr>
<td>Attendance (Theory &amp; Practical)</td>
<td>05</td>
</tr>
</tbody>
</table>

Oral examination will be based on the above and CSC703: ‘AI and SC’ Syllabus.
**Lab Code** | **Lab Name** | **Credits**  
---|---|---  
CSL703 | Computational Lab-I | 1

**Lab Outcome:** After successful completion of this course student will be able to:

1. Acquire practical knowledge within the chosen area of technology for project development.
2. Identify, discuss and justify the technical aspects of the chosen project with a comprehensive and systematic approach.

**Description:**
Design and implementation of any case study/applications/experiments/mini project based on departmental level optional courses using modern tools.

**Term work:**
The distribution of marks for **term work** shall be as follows:

- Lab/Experimental Work : 15
- Report/Documentation : 05
- Attendance (Theory & Practical) : 05

**Practical & Oral** examination is to be conducted based on respective departmental level optional courses by pair of internal and external examiners appointed by the University of Mumbai.
Objective: The Project work enables students to develop further skills and knowledge gained during the programme by applying them to the analysis of a specific problem or issue, via a substantial piece of work carried out over an extended period. For students to demonstrate proficiency in the design of a research project, application of appropriate research methods, collection and analysis of data and presentation of results.

Guidelines:
1. Project Topic:
   - To proceed with the project work it is very important to select a right topic. Project can be undertaken on any subject addressing IT programme. Research and development projects on problems of practical and theoretical interest should be encouraged.
   - Project work must be carried out by the group of at least two students and maximum three and must be original.
   - Students can certainly take ideas from anywhere, but be sure that they should evolve them in the unique way to suit their project requirements.
   - The project work can be undertaken in a research institute or organization/company/any business establishment.
   - Student must consult internal guide along with external guide (if any) in selection of topic.
   - Head of department and senior staff in the department will take decision regarding selection of projects.
   - Student has to submit weekly progress report to the internal guide and where as internal guide has to keep track on the progress of the project and also has to maintain attendance report. This progress report can be used for awarding term work marks.
   - In case of industry projects, visit by internal guide will be preferred.

2. Project Report Format:
   At the end of semester a project report should preferably contain at least following details:-
   - Abstract
   - Introduction
   - Literature Survey
     - Survey Existing system
     - Limitation Existing system or research gap
     - Problem Statement and Objective
     - Scope
   - Proposed System
     - Analysis/Framework/ Algorithm
     - Details of Hardware & Software
     - Design details
     - Methodology (your approach to solve the problem)
3. Term Work:
Distribution of marks for term work shall be as follows:
   a. Weekly Attendance on Project Day
   b. Project work contribute
   c. Project Report (Spiral Bound)
   d. Term End Presentation (Internal)

The final certification and acceptance of TW ensures the satisfactory performance on the above aspects.

4. Oral & Practical:
   Oral & Practical examination of Project-I should be conducted by Internal and External examiners approved by University of Mumbai. Students have to give presentation and demonstration on the Project-I.
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSC801</td>
<td>Human Machine Interaction</td>
<td>4</td>
</tr>
</tbody>
</table>

**Course Objectives:** At the end of the course, students will be able to –
1. Learn the foundation of human machine interaction.
2. Understand the importance of human psychology in designing good interfaces.
3. Be aware of mobile interaction design and its usage in day – to – day activities.
4. Understand various design technologies to meet user requirements.
5. Encourage to indulge into research in Machine Interaction Design.

**Course Outcomes:** At the end of the course, the students will be able to -
1. Identify User Interface (UI) design principles.
2. Analysis of effective user friendly interfaces.
3. Apply Interactive Design process in real world applications.
4. Evaluate UI design and justify.
5. Create application for social and technical task.

**Pre-requisites:** Web Technologies; Software Engineering; Experience in designing interfaces for applications and web sites. Basic knowledge of designing tools and languages like HTML, Java, etc

<table>
<thead>
<tr>
<th>Module No.</th>
<th>Topics</th>
<th>Hrs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>FOUNDATIONS OF HMI:</td>
<td>8</td>
</tr>
<tr>
<td>2.0</td>
<td>DESIGN &amp; SOFTWARE PROCESS:</td>
<td>10</td>
</tr>
<tr>
<td>3.0</td>
<td>GRAPHICAL USER INTERFACE:</td>
<td>8</td>
</tr>
<tr>
<td>4.0</td>
<td>SCREEN DESIGNING:</td>
<td></td>
</tr>
<tr>
<td>-----</td>
<td>-----------------</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Design goals, Screen planning and purpose, organizing screen elements, ordering of screen data and content, screen navigation and flow, Visually pleasing composition, amount of information, focus and emphasis, presentation information simply and meaningfully, information retrieval on web, statistical graphics, Technological consideration in interface design.</td>
<td>10</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>5.0</th>
<th>INTERFACE DESIGN FOR MOBILE DEVICES:</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>6.0</th>
<th>INTERACTION STYLES AND COMMUNICATION:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Windows: Characteristics, Components, Presentation styles, Types of Windows, Management, operations. Text messages: Words, Sentences, messages and text words, Text for web pages. Icons, Multimedia and colors</td>
</tr>
</tbody>
</table>

**Total**: 52

**Text Books:**

**Reference Books:**

**Assessment:**

**Internal Assessment:**
Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.

**End Semester Theory Examination:**
1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.
Course Code: CSC802  
Course Name: Distributed Computing  
Credits: 04

Course objectives:
1. To provide students with contemporary knowledge in distributed systems
2. To equip students with skills to analyze and design distributed applications.
3. To provide master skills to measure the performance of distributed synchronization algorithms

Course outcomes: On successful completion of course learner will be able to:
1. Demonstrate knowledge of the basic elements and concepts related to distributed system technologies;
2. Illustrate the middleware technologies that support distributed applications such as RPC, RMI and Object based middleware.
3. Analyze the various techniques used for clock synchronization and mutual exclusion
4. Demonstrate the concepts of Resource and Process management and synchronization algorithms
5. Demonstrate the concepts of Consistency and Replication Management
6. Apply the knowledge of Distributed File System to analyze various file systems like NFS, AFS and the experience in building large-scale distributed applications.

Prerequisite: Java Programming, Operating Systems, Computer Networks

<table>
<thead>
<tr>
<th>Module No.</th>
<th>Unit No.</th>
<th>Topics</th>
<th>Hrs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>Introduction to Distributed Systems</td>
<td></td>
<td>06</td>
</tr>
<tr>
<td>1.1</td>
<td>Characterization of Distributed Systems: Issues, Goals, and Types of distributed systems, Distributed System Models, Hardware concepts, Software Concept.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.2</td>
<td>Middleware: Models of Middleware, Services offered by middleware, Client Server model.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.0</td>
<td>Communication</td>
<td></td>
<td>10</td>
</tr>
<tr>
<td>2.1</td>
<td>Layered Protocols, Interprocess communication (IPC): MPI, Remote Procedure Call (RPC), Remote Object Invocation, Remote Method Invocation (RMI)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.2</td>
<td>Message Oriented Communication, Stream Oriented Communication, Group Communication</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.0</td>
<td>Synchronization</td>
<td></td>
<td>10</td>
</tr>
<tr>
<td>3.1</td>
<td>Clock Synchronization, Logical Clocks, Election Algorithms, Mutual Exclusion, Distributed Mutual Exclusion-Classification of mutual Exclusion Algorithm, Requirements of Mutual Exclusion Algorithms, Performance measure.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.2</td>
<td>Non Token based Algorithms: Lamport Algorithm, Ricart–Agrawala’s Algorithm, Maekawa’s Algorithm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.3</td>
<td>Token Based Algorithms: Suzuki-Kasami’s Broadcast Algorithms, Singhal’s Heuristic Algorithm, Raymond’s Tree based Algorithm, Comparative Performance Analysis.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.0</td>
<td>Resource and Process Management</td>
<td></td>
<td>06</td>
</tr>
<tr>
<td>4.1</td>
<td>Desirable Features of global Scheduling algorithm, Task assignment approach, Load balancing approach, load sharing approach</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.2</td>
<td>Introduction to process management, process migration, Threads</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Virtualization, Clients, Servers, Code Migration

5.0 Consistency, Replication and Fault Tolerance 08

5.1 Introduction to replication and consistency, Data-Centric and Client-Centric Consistency Models, Replica Management

5.2 Fault Tolerance: Introduction, Process resilience, Reliable client-server and group communication, Recovery

6.0 Distributed File Systems and Name Services 12

6.1 Introduction and features of DFS, File models, File Accessing models, File-Caching Schemes, File Replication, Case Study: Distributed File Systems (DSF), Network File System (NFS), Andrew File System (AFS)

6.2 Introduction to Name services and Domain Name System, Directory Services, Case Study: The Global Name Service, The X.500 Directory Service

6.3 Designing Distributed Systems: Google Case Study

**Assessment:**

**Internal Assessment:**
Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.

**End Semester Theory Examination:**
a. Question paper will comprise of 6 questions, each carrying 20 marks.
b. The students need to solve total 4 questions.
c. Question No.1 will be compulsory and based on entire syllabus.
d. Remaining question (Q.2 to Q.6) will be selected from all the modules.

**Text Books:**

**Reference Books:**
Course Code                  Course Name                      Credit
DLO8011                      High Performance Computing     04

Course Objectives:
1. To learn concepts of parallel processing as it pertains to high-performance computing.
2. To design, develop and analyze parallel programs on high performance computing resources using parallel programming paradigms.

Course Outcomes: Learner will be able to:
1. Memorize parallel processing approaches
2. Describe different parallel processing platforms involved in achieving High Performance Computing.
3. Discuss different design issues in parallel programming
4. Develop efficient and high performance parallel programming
5. Learn parallel programming using message passing paradigm using open source APIs.

Prerequisite: Computer Organization

<table>
<thead>
<tr>
<th>Sr.No.</th>
<th>Module</th>
<th>Detailed Content</th>
<th>Hours</th>
</tr>
</thead>
</table>
| 1      | Introduction                    | **Introduction to Parallel Computing:** Motivating Parallelism, Scope of Parallel Computing, Levels of parallelism (instruction, transaction, task, thread, memory, function)  
**Classification Models:** Architectural Schemes (Flynn’s, Shore’s, Feng’s, Handler’s) and Memory access (Shared Memory, Distributed Memory, Hybrid Distributed Shared Memory)  
**Parallel Architectures:** Pipeline Architecture, Array Processor, Multiprocessor Architecture, Systolic Architecture, Data Flow Architecture | 6     |
| 2      | Pipeline Processing             | Introduction, Pipeline Performance, Arithmetic Pipelines, Pipeline instruction processing, Pipeline stage design, Hazards, Dynamic instruction scheduling | 8     |
| 3      | Parallel Programming Platforms  | Parallel Programming Platforms: Implicit Parallelism: Trends in Microprocessor & Architectures, Limitations of Memory System Performance, Dichotomy of Parallel Computing Platforms, Physical Organization of Parallel Platforms, Communication Costs in Parallel Machines | 10    |
5 Performance Measures


6 HPC Programming


Text Books:


Reference Books:


Internal Assessment: Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

Theory Examination:

1. Question paper will comprise of total six questions.
2. All question carry equal marks.
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3).
4. Only Four question need to be solved.
In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

Laboratory Work:

Description: The Laboratory Work (Experiments) for this course is required to be performed and to be evaluated in CSL803: Computational Lab-II

Suggested Experiment List:

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Detailed Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Execution of Simple Hello world program on MPI platform</td>
</tr>
</tbody>
</table>
| 2       | a. Program to send data and receive data to/from processors using MPI  
          | b. Program illustrating Broadcast of data using MPI |
| 3       | Implement a parallel program to demonstrate the cube of N number within a set range. |
| 4       | Write a parallel program for area of a circle/triangle |
| 5       | Implement a program to demonstrate balancing of workload on MPI platform |
| 6       | Using directives of MPI/OpenMP implement parallel programming for calculator application (add, sub, multiplication and division) |
| 7       | **Mini Project**  
          | Evaluate performance enhancement of HPC for any of the following:  
          | One-Dimensional Matrix-Vector Multiplication/ Single-Source Shortest-Path/ Sample Sort/Two-Dimensional Matrix-Vector Multiplication |
Course Code | Course Name | Credits
--- | --- | ---
DLO8012 | Natural Language Processing | 4

Course objectives:
1. To understand natural language processing and to learn how to apply basic algorithms in this field.
2. To get acquainted with the basic concepts and algorithmic description of the main language levels: morphology, syntax, semantics, and pragmatics.
3. To design and implement applications based on natural language processing
4. To implement various language Models.
5. To design systems that uses NLP techniques

Course outcomes: On successful completion of course learner should:
1. Have a broad understanding of the field of natural language processing.
2. Have a sense of the capabilities and limitations of current natural language technologies,
3. Be able to model linguistic phenomena with formal grammars.
4. Be able to Design, implement and test algorithms for NLP problems
5. Understand the mathematical and linguistic foundations underlying approaches to the various areas in NLP
6. Be able to apply NLP techniques to design real world NLP applications such as machine translation, text categorization, text summarization, information extraction...etc.

Prerequisite: Data structure & Algorithms, Theory of computer science, Probability Theory.

<table>
<thead>
<tr>
<th>Module No.</th>
<th>Unit No.</th>
<th>Topics</th>
<th>Hrs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Introduction</td>
<td>History of NLP, Generic NLP system, levels of NLP, Knowledge in language processing, Ambiguity in Natural language, stages in NLP, challenges of NLP, Applications of NLP</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>Word Level Analysis</td>
<td>Morphology analysis – survey of English Morphology, Inflectional morphology &amp; Derivational morphology, Lemmatization, Regular expression, finite automata, finite state transducers (FST), Morphological parsing with FST, Lexicon free FST Porter stemmer. N- Grams - N-gram language model, N-gram for spelling correction.</td>
<td>10</td>
</tr>
<tr>
<td>3</td>
<td>Syntax analysis</td>
<td>Part-Of-Speech tagging (POS) - Tag set for English (Penn Treebank), Rule based POS tagging, Stochastic POS tagging, Issues – Multiple tags &amp; words, Unknown words. Introduction to CFG, Sequence labeling: Hidden Markov Model (HMM), Maximum Entropy, and Conditional Random Field (CRF).</td>
<td>10</td>
</tr>
<tr>
<td>4</td>
<td>Semantic Analysis</td>
<td>Lexical Semantics, Attachment for fragment of English- sentences, noun phrases, Verb phrases, prepositional phrases, Relations among lexemes &amp; their senses – Homonymy, Polysemy, Synonymy, Hyponymy, WordNet, Robust Word Sense Disambiguation (WSD), Dictionary based approach</td>
<td>10</td>
</tr>
</tbody>
</table>
5 Pragmatics Discourse – reference resolution, reference phenomenon, syntactic & semantic constraints on co reference 8

6 Applications (preferably for Indian regional languages) Machine translation, Information retrieval, Question answers system, categorization, summarization, sentiment analysis, Named Entity Recognition. 10

Text Books:

Reference Books:
2. Daniel M Bikel and Imed Zitouni “ Multilingual natural language processing applications” Pearson, 2013
3. Alexander Clark (Editor), Chris Fox (Editor), Shalom Lappin (Editor) “ The Handbook of Computational Linguistics and Natural Language Processing “ ISBN: 978-1-118-
4. Steven Bird, Ewan Klein, Natural Language Processing with Python, O’Reilly
5. Brian Neil Levine, An Introduction to R Programming

Assessment:

Internal Assessment:
Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.

End Semester Theory Examination:
1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.
Laboratory Work/Case study/Experiments:

**Description:** The Laboratory Work (Experiments) for this course is required to be performed and to be evaluated in CSL803: Computational Lab-II

The objective of Natural Language Processing lab is to introduce the students with the basics of NLP which will empower them for developing advanced NLP tools and solving practical problems in this field.

Reference for Experiments: [http://cse24-iiith.virtual-labs.ac.in/#](http://cse24-iiith.virtual-labs.ac.in/#)

Reference for NPTEL: [http://www.cse.iitb.ac.in/~cs626-449](http://www.cse.iitb.ac.in/~cs626-449)

**Sample Experiments:** possible tools / language: R tool/ Python programming Language

Note: Although it is not mandatory, the experiments can be conducted with reference to any Indian regional language.

1. Preprocessing of text (Tokenization, Filtration, Script Validation, Stop Word Removal, Stemming)
2. Morphological Analysis
3. N-gram model
4. POS tagging
5. Chunking
6. Named Entity Recognition
7. Case Study/ Mini Project based on Application mentioned in Module 6.
Course Code | Course Name | Credits
---|---|---
DLO8013 | Adhoc Wireless Networks | 4

**Course objectives:**
1. To Identify the major issues associated with ad-hoc networks
2. To identify the requirements for protocols for wireless ad-hoc networks as compared to the protocols existing for wired network.
3. To explore current ad-hoc technologies by researching key areas such as algorithms, protocols, hardware, and applications.
4. To Provide hands-on experience through real-world programming projects
5. To provide advanced in-depth networking materials to graduate students in networking research.

**Course outcomes:** On successful completion of course learner will be able to:
1. Identify the characteristics and features of Adhoc Networks.
2. Understand the concepts & be able to design MAC protocols for Ad Hoc networks
3. Implement protocols / Carry out simulation of routing protocols of Adhoc Networks
4. Interpret the flow control in transport layer of Ad Hoc Networks
5. Analyze security principles for routing of Ad Hoc Networks
6. Utilize the concepts of Adhoc Networks in VANETs

**Prerequisite:** Computer Network, Wireless Networking

<table>
<thead>
<tr>
<th>Module No.</th>
<th>Unit No.</th>
<th>Topics</th>
<th>Hrs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>1.1</td>
<td>Introduction to wireless Networks. Characteristics of Wireless channel, Issues in Ad hoc wireless networks, Adhoc Mobility Models:- Indoor and outdoor models, Introduction to Adhoc networks – definition, characteristics features, applications.</td>
<td>04</td>
</tr>
<tr>
<td></td>
<td>2.0</td>
<td>MAC protocols for Wireless Ad-Hoc Networks</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>2.1</td>
<td>Introduction</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2.2</td>
<td>Issues in designing MAC for Wireless Ad-Hoc Networks</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2.3</td>
<td>Design Goals and classification of MAC for Wireless Ad-Hoc Networks</td>
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<tr>
<td></td>
<td>2.4</td>
<td>Contention based MAC protocols for Wireless Ad-Hoc Networks, with reservation mechanisms, scheduling Mechanisms</td>
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<tr>
<td></td>
<td>2.5</td>
<td>MAC protocols using directional antennas, Other MAC Protocols</td>
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<tr>
<td></td>
<td>2.6</td>
<td>IEEE standards MAC Protocols: 802.15.1(WPAN based on Bluetooth), 802.15.4 (WSN/Zigbee), 802.15.6 (WBAN).</td>
<td></td>
</tr>
<tr>
<td>3.0</td>
<td>3.1</td>
<td>Routing Protocols for Wireless Ad-Hoc Networks</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>3.2</td>
<td>Introduction, Issues in designing a routing protocol for Wireless Ad-Hoc Networks</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3.3</td>
<td>Classification of routing protocols, Table driven routing protocols like DSDV, WRP.</td>
<td></td>
</tr>
</tbody>
</table>
On-demand routing protocols like ABR, DSR, TORA, AODV, etc.

3.3 Hybrid Routing Protocols: ZRP, Routing Protocols with efficient flooding mechanism, Hierarchical Routing Protocols, Power aware routing protocols

4.0 Transport Layer

4.1 Transport layer protocols for Ad hoc wireless Networks: Introduction.

4.2 Issues in designing a transport layer protocol for Ad hoc wireless Networks.

4.3 Design goals of a transport layer protocol for Ad hoc wireless Networks.

4.4 Classification of transport layer solutions: Split Approach, End-to-End approach :TCP-F, TCP-ELFN, Ad-Hoc TCP, TCP Buffering capability and Sequencing information

4.5 End-to-End Quality of Service

5.0 Security

5.1 Security attacks in wireless Ad hoc wireless Networks, Network security requirements.

5.2 Issues & challenges in security provisioning.

5.3 Link Layer security attacks: 802.11 MAC, WPA and variations

5.4 Network Security Attacks: Routing Protocol Attacks: attacks using falsifying route errors and broadcasting falsifying routes, spoofing attacks, Rushing attacks, Secure routing in Ad hoc wireless Networks

6.0 Vehicular Ad-Hoc Network (VANET)

6.1 Introduction: Challenges and Requirements, Layered architecture for VANETs, DSRC /WAVE standard (IEEE 802.11p).

6.2 IEEE 802.11p protocol Stack (PHY & MAC), A Survey on Proposed MAC Approaches for VANETs like TDMA, SDMA and CDMA based approaches, DSRC MAC & LLC

6.3 Georouting: CBF, Flooding with broadcast suppression

6.4 Delay Tolerant Network, Introduction to Opportunistic Networking in Delay Tolerant Vehicular Ad Hoc Networks

Total 52

Assessment:

Internal Assessment:
Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.

End Semester Theory Examination:
1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.
Text Books:

Reference Books:

Laboratory Work

Lab Outcome:
1. Explore the knowledge of NS2 and NS3 by installing it and make it ready
2. Shall synthesize a simulation and evaluate the performance of WLAN 802.11 and Bluetooth
3. Students will able to analyze and implement MAC & Network layer protocols using open source and synthesis as well as evaluate its performance
4. Implement Transport layer protocols / Carry out simulation of routing protocols of Adhoc Networks
5. Describe and interpret the use security routines and evaluate its performance
6. Explore and understand the capability of SUMO and MOVE as well as Nessi by installing it and analyze it by applying on various scenarios

Description: It is recommended that Network simulation Softwares like NS-2, NS-3, SUMO (Simulation software for Urban MObility) with MOVE. Software like Nessi is also recommended for the event based security attacks simulation and measure.

The Laboratory Work (Experiments) for this course is required to be performed and to be evaluated in CSL803: Computational Lab-II

Suggested List of Experiments:

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Title of Experiments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Installation of NS2 &amp; NS3 in Fedora 19 (32 bit) OS Linux.</td>
</tr>
<tr>
<td>2</td>
<td>Simulating IEEE 802.11 wireless LAN in Ad-Hoc Mode using NS2</td>
</tr>
<tr>
<td>3</td>
<td>Implementation a Bluetooth network in NS3 with application as transfer of a file from one device to another</td>
</tr>
<tr>
<td>4</td>
<td>To implement and compare MAC layer protocols, MACAW, MACA-BI and MACA with piggybacked Reservation using NS-3</td>
</tr>
</tbody>
</table>

University of Mumbai, B. E. (Computer Engineering), Rev. 2016
| 5 | Develop sample wireless network in which  
a. implement AODV and AOMDV protocol  
b. Calculate the time to receive reply from the receiver using NS2.  
c. Generate graphs which show the transmission time for packet.  
Implement wireless network. Capture data frame and identify fields using NS2. |
| 6 | Communicate between two different networks (NS-3) which has following specifications:  
a. One network has Class A network with “TORA protocol”  
b. Second has Class B network “AODV protocol” |
| 7 | To calculate and compare average throughput for various TCP variants like TCP-F (Feedback) and Ad-Hoc TCP using NS-3 |
| 8 | Explore and use security tools like WEP & WPA and evaluate its performance on mobile terminals |
| 9 | Simulation of Urban Mobility (SUMO) along with MOVE is software that helps in simulating the VANETs. Install it on Fedora 19 (32 bit) OS Linux |
| 10 | Create a simulation for road traffic with 6 junctions. There are various vehicles going on and your own car also. Select a shortest route for your car. Demonstrate with simulation software SUMO and MOVE. |
| 11 | A car acts as a malicious node and can be analyzed for the packet loss before and after malicious activity. Using SUMO and MOVE. |
| 12 | Create an Ad-hoc Network using nessi Simulation software and include events incorporate dropped packets, infected flows, compromised machines, unavailable services etc, and check its performance |

Digital Material (if Any):

1. [http://www.isi.edu/nsnam/ns/](http://www.isi.edu/nsnam/ns/) : NS-2 software download (D1)
2. [https://nsnam.isi.edu/nsnam/index.php/NS_manual](https://nsnam.isi.edu/nsnam/index.php/NS_manual) (D2)
3. [https://www.nsnam.org/](https://www.nsnam.org/) : Ns-3 Software Download (D3)
5. [http://www.sumo.dlr.de/userdoc/Tutorials/Quick_Start.html](http://www.sumo.dlr.de/userdoc/Tutorials/Quick_Start.html) (D5)

Text Books:

4. Michael Gregg, “Build your own security lab,” Wiley India edition (T4)
Objectives:
1. To familiarize the students with the use of a structured methodology/approach for each and every unique project undertaken, including utilizing project management concepts, tools and techniques.
2. To appraise the students with the project management life cycle and make them knowledgeable about the various phases from project initiation through closure.

Outcomes: Learner will be able to…
1. Apply selection criteria and select an appropriate project from different options.
2. Write work break down structure for a project and develop a schedule based on it.
3. Identify opportunities and threats to the project and decide an approach to deal with them strategically.
4. Use Earned value technique and determine & predict status of the project.
5. Capture lessons learned during project phases and document them for future reference.

<table>
<thead>
<tr>
<th>Module</th>
<th>Detailed Contents</th>
<th>Hrs</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td><strong>Project Management Foundation:</strong> Definition of a project, Project Vs Operations, Necessity of project management, Triple constraints, Project life cycles (typical &amp; atypical) Project phases and stage gate process. Role of project manager, Negotiations and resolving conflicts, Project management in various organization structures, PM knowledge areas as per Project Management Institute (PMI)**</td>
<td>5</td>
</tr>
<tr>
<td>02</td>
<td><strong>Initiating Projects:</strong> How to get a project started, Selecting project strategically, Project selection models (Numeric /Scoring Models and Non-numeric models), Project portfolio process, Project sponsor and creating charter; Project proposal. Effective project team, Stages of team development &amp; growth (forming, storming, norming &amp;performing), team dynamics.</td>
<td>6</td>
</tr>
<tr>
<td>03</td>
<td><strong>Project Planning and Scheduling:</strong> Work Breakdown structure (WBS) and linear responsibility chart, Interface Co-ordination and concurrent engineering, Project cost estimation and budgeting, Top down and bottoms up budgeting, Networking and Scheduling techniques. PERT, CPM, GANTT chart, Introduction to Project Management Information System (PMIS).</td>
<td>8</td>
</tr>
<tr>
<td>04</td>
<td><strong>Planning Projects:</strong> Crashing project time, Resource loading and levelling, Goldratt's critical chain, Project Stakeholders and Communication plan Risk Management in projects: Risk management planning, Risk identification and risk register, Qualitative and quantitative risk assessment, Probability and impact matrix. Risk response strategies for positive and negative risks</td>
<td>6</td>
</tr>
<tr>
<td>05</td>
<td><strong>5.1 Executing Projects:</strong> Planning monitoring and controlling cycle, Information needs and reporting, engaging with all stakeholders of the projects, Team management, communication and project meetings <strong>5.2 Monitoring and Controlling Projects:</strong> Earned Value Management techniques for measuring value of work completed; Using milestones for measurement; change requests and scope creep, Project audit</td>
<td>8</td>
</tr>
</tbody>
</table>
5.3 Project Contracting
Project procurement management, contracting and outsourcing.

6.1 Project Leadership and Ethics:
Introduction to project leadership, ethics in projects, Multicultural and virtual projects

6.2 Closing the Project:
Customer acceptance; Reasons of project termination, Various types of project terminations (Extinction, Addition, Integration, Starvation), Process of project termination, completing a final report; doing a lessons learned analysis; acknowledging successes and failures; Project management templates and other resources; Managing without authority; Areas of further study.

Assessment:

Internal Assessment for 20 marks:
Consisting Two Compulsory Class Tests
First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:
Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total six questions, each carrying 20 marks
2. Question 1 will be compulsory and should cover maximum contents of the curriculum
3. Remaining questions will be mixed in nature (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four questions need to be solved

REFERENCES:

1. Project Management: A managerial approach, Jack Meredith & Samuel Mantel, 7th Edition, Wiley India
3. Project Management, Gido Clements, Cengage Learning
4. Project Management, Gopalan, Wiley India
Objectives:
1. Overview of Indian financial system, instruments and market
2. Basic concepts of value of money, returns and risks, corporate finance, working capital and its management
3. Knowledge about sources of finance, capital structure, dividend policy

Outcomes: Learner will be able to…
1. Understand Indian finance system and corporate finance
2. Take investment, finance as well as dividend decisions

<table>
<thead>
<tr>
<th>Module</th>
<th>Detailed Contents</th>
<th>Hrs</th>
</tr>
</thead>
<tbody>
<tr>
<td>02</td>
<td>Concepts of Returns and Risks: Measurement of Historical Returns and Expected Returns of a Single Security and a Two-security Portfolio; Measurement of Historical Risk and Expected Risk of a Single Security and a Two-security Portfolio. Time Value of Money: Future Value of a Lump Sum, Ordinary Annuity, and Annuity Due; Present Value of a Lump Sum, Ordinary Annuity, and Annuity Due; Continuous Compounding and Continuous Discounting.</td>
<td>06</td>
</tr>
<tr>
<td>03</td>
<td>Overview of Corporate Finance: Objectives of Corporate Finance; Functions of Corporate Finance—Investment Decision, Financing Decision, and Dividend Decision. Financial Ratio Analysis: Overview of Financial Statements—Balance Sheet, Profit and Loss Account, and Cash Flow Statement; Purpose of Financial Ratio Analysis; Liquidity Ratios; Efficiency or Activity Ratios; Profitability Ratios; Capital Structure Ratios; Stock Market Ratios; Limitations of Ratio Analysis.</td>
<td>09</td>
</tr>
<tr>
<td>04</td>
<td>Capital Budgeting: Meaning and Importance of Capital Budgeting; Inputs for Capital Budgeting Decisions; Investment Appraisal Criterion—Accounting Rate of Return, Payback Period, Discounted Payback Period, Net Present Value(NPV), Profitability Index, Internal Rate of Return (IRR), and Modified Internal Rate of Return (MIRR) Working Capital Management: Concepts of Meaning Working Capital; Importance of Working Capital Management; Factors Affecting an Entity’s Working Capital Needs; Estimation of Working Capital Requirements; Management of Inventories; Management of Receivables; and Management of Cash and Marketable Securities.</td>
<td>10</td>
</tr>
<tr>
<td>05</td>
<td>Sources of Finance: Long Term Sources—Equity, Debt, and Hybrids; Mezzanine</td>
<td>05</td>
</tr>
</tbody>
</table>
Finance; Sources of Short Term Finance—Trade Credit, Bank Finance, Commercial Paper; Project Finance.

**Capital Structure:** Factors Affecting an Entity’s Capital Structure; Overview of Capital Structure Theories and Approaches—Net Income Approach, Net Operating Income Approach; Traditional Approach, and Modigliani-Miller Approach. Relation between Capital Structure and Corporate Value; Concept of Optimal Capital Structure

**Dividend Policy:** Meaning and Importance of Dividend Policy; Factors Affecting an Entity’s Dividend Decision; Overview of Dividend Policy Theories and Approaches—Gordon’s Approach, Walter’s Approach, and Modigliani-Miller Approach

**Assessment:**

**Internal Assessment for 20 marks:**
Consisting Two Compulsory Class Tests
First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

**End Semester Examination:**
Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total six questions, each carrying 20 marks
2. Question 1 will be compulsory and should cover maximum contents of the curriculum
3. Remaining questions will be mixed in nature (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four questions need to be solved.

**REFERENCES:**

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<tbody>
<tr>
<td>01</td>
<td><strong>Overview Of Entrepreneurship:</strong> Definitions, Roles and Functions/Values of Entrepreneurship, History of Entrepreneurship Development, Role of Entrepreneurship in the National Economy, Functions of an Entrepreneur, Entrepreneurship and Forms of Business Ownership Role of Money and Capital Markets in Entrepreneurial Development: Contribution of Government Agencies in Sourcing information for Entrepreneurship</td>
<td>04</td>
</tr>
<tr>
<td>02</td>
<td><strong>Business Plans And Importance Of Capital To Entrepreneurship:</strong> Preliminary and Marketing Plans, Management and Personnel, Start-up Costs and Financing as well as Projected Financial Statements, Legal Section, Insurance, Suppliers and Risks, Assumptions and Conclusion, Capital and its Importance to the Entrepreneur <strong>Entrepreneurship And Business Development:</strong> Starting a New Business, Buying an Existing Business, New Product Development, Business Growth and the Entrepreneur Law and its Relevance to Business Operations</td>
<td>09</td>
</tr>
<tr>
<td>03</td>
<td>Women’s Entrepreneurship Development, Social entrepreneurship-role and need, EDP cell, role of sustainability and sustainable development for SMEs, case studies, exercises</td>
<td>05</td>
</tr>
<tr>
<td>04</td>
<td><strong>Indian Environment for Entrepreneurship:</strong> key regulations and legal aspects , MSMED Act 2006 and its implications, schemes and policies of the Ministry of MSME, role and responsibilities of various government organisations, departments, banks etc., Role of State governments in terms of infrastructure developments and support etc., Public private partnerships, National Skill development Mission, Credit Guarantee Fund, PMEGP, discussions, group exercises etc</td>
<td>08</td>
</tr>
<tr>
<td>05</td>
<td><strong>Effective Management of Business:</strong> Issues and problems faced by micro and small enterprises and effective management of M and S enterprises (risk management, credit availability, technology innovation, supply chain management, linkage with large industries), exercises, e-Marketing</td>
<td>08</td>
</tr>
<tr>
<td>06</td>
<td><strong>Achieving Success In The Small Business:</strong> Stages of the small business life cycle, four types of firm-level growth strategies, Options – harvesting or closing small business Critical Success factors of small business</td>
<td>05</td>
</tr>
</tbody>
</table>
Assessment:

Internal Assessment for 20 marks:
Consisting Two Compulsory Class Tests
First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:
Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total six questions, each carrying 20 marks
2. Question 1 will be compulsory and should cover maximum contents of the curriculum
3. Remaining questions will be mixed in nature (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four questions need to be solved.

REFERENCES:

1. Poornima Charantimath, Entrepreneurship development- Small Business Enterprise, Pearson
3. Dr TN Chhabra, Entrepreneurship Development, Sun India Publications, New Delhi
4. Dr CN Prasad, Small and Medium Enterprises in Global Perspective, New century Publications, New Delhi
5. Vasant Desai, Entrepreneurial development and management, Himalaya Publishing House
6. Maddhurima Lall, Shikha Sahai, Entrepreneurship, Excel Books
7. Rashmi Bansal, STAY hungry STAY foolish, CIIE, IIM Ahmedabad
8. Law and Practice relating to Micro, Small and Medium enterprises, Taxmann Publication Ltd.
10. Laghu Udyog Samachar
11. www.msme.gov.in
12. www.dcmesme.gov.in
13. www.msmetraining.gov.in
Objectives:
1. To introduce the students with basic concepts, techniques and practices of the human resource management
2. To provide opportunity of learning Human resource management (HRM) processes, related with the functions, and challenges in the emerging perspective of today’s organizations
3. To familiarize the students about the latest developments, trends & different aspects of HRM
4. To acquaint the student with the importance of inter-personal & inter-group behavioural skills in an organizational setting required for future stable engineers, leaders and managers

Outcomes: Learner will be able to…
1. Understand the concepts, aspects, techniques and practices of the human resource management.
2. Understand the Human resource management (HRM) processes, functions, changes and challenges in today’s emerging organizational perspective.
3. Gain knowledge about the latest developments and trends in HRM.
4. Apply the knowledge of behavioural skills learnt and integrate it with in inter personal and intergroup environment emerging as future stable engineers and managers.

<table>
<thead>
<tr>
<th>Module</th>
<th>Detailed Contents</th>
<th>Hrs</th>
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</thead>
<tbody>
<tr>
<td>01</td>
<td>Introduction to HR</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Human Resource Management- Concept, Scope and Importance, Interdisciplinary Approach Relationship with other Sciences, Competencies of HR Manager, HRM functions</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>• Human resource development (HRD): changing role of HRM – Human resource Planning, Technological change, Restructuring and rightsizing, Empowerment, TQM, Managing ethical issues</td>
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</tr>
<tr>
<td>02</td>
<td>Organizational Behaviour (OB)</td>
<td></td>
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<tr>
<td></td>
<td>• Introduction to OB Origin, Nature and Scope of Organizational Behaviour, Relevance to Organizational Effectiveness and Contemporary issues</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>• Personality: Meaning and Determinants of Personality, Personality development, Personality Types, Assessment of Personality Traits for Increasing Self Awareness</td>
<td></td>
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<tr>
<td></td>
<td>• Perception: Attitude and Value, Effect of perception on Individual Decision-making, Attitude and Behaviour</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Motivation: Theories of Motivation and their Applications for Behavioural Change (Maslow, Herzberg, McGregor);</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Group Behaviour and Group Dynamics: Work groups formal and informal groups and stages of group development, Team Effectiveness: High performing teams, Team Roles, cross functional and self-directed team.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Case study</td>
<td></td>
</tr>
<tr>
<td>03</td>
<td>Organizational Structure &amp;Design</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Structure, size, technology, Environment of organization; Organizational Roles &amp; conflicts: Concept of roles; role dynamics; role conflicts and stress.</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>• Leadership: Concepts and skills of leadership, Leadership and managerial roles, Leadership styles and contemporary issues in leadership.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Power and Politics: Sources and uses of power; Politics at workplace, Tactics and strategies.</td>
<td></td>
</tr>
</tbody>
</table>
Human resource Planning
- Recruitment and Selection process, Job-enrichment, Empowerment - Job-Satisfaction, employee morale
- Performance Appraisal Systems: Traditional & modern methods, Performance Counselling, Career Planning
- Training & Development: Identification of Training Needs, Training Methods

Emerging Trends in HR
- Organizational development; Business Process Re-engineering (BPR), BPR as a tool for organizational development, managing processes & transformation in HR, Organizational Change, Culture, Environment
- Cross Cultural Leadership and Decision Making: Cross Cultural Communication and diversity at work, Causes of diversity, managing diversity with special reference to handicapped, women and ageing people, intra company cultural difference in employee motivation

HR & MIS: Need, purpose, objective and role of information system in HR, Applications in HRD in various industries (e.g. manufacturing R&D, Public Transport, Hospitals, Hotels and service industries

Strategic HRM: Role of Strategic HRM in the modern business world, Concept of Strategy, Strategic Management Process, Approaches to Strategic Decision Making; Strategic Intent – Corporate Mission, Vision, Objectives and Goals

Labor Laws & Industrial Relations: Evolution of IR, IR issues in organizations, Overview of Labor Laws in India; Industrial Disputes Act, Trade Unions Act, Shops and Establishments Act

Internal Assessment for 20 marks:
Consisting Two Compulsory Class Tests
First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:
Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total six questions, each carrying 20 marks
2. Question 1 will be compulsory and should cover maximum contents of the curriculum
3. Remaining questions will be mixed in nature (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four questions need to be solved.

REFERENCES:
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>ILO8025</td>
<td>Professional Ethics and Corporate Social Responsibility (CSR)</td>
<td>03</td>
</tr>
</tbody>
</table>

**Objectives:**
1. To understand professional ethics in business
2. To recognize corporate social responsibility

**Outcomes:** Learner will be able to...
1. Understand rights and duties of business
2. Distinguish different aspects of corporate social responsibility
3. Demonstrate professional ethics
4. Understand legal aspects of corporate social responsibility

<table>
<thead>
<tr>
<th>Module</th>
<th>Detailed Contents</th>
<th>Hrs</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td><strong>Professional Ethics and Business:</strong> The Nature of Business Ethics; Ethical Issues in Business; Moral Responsibility and Blame; Utilitarianism: Weighing Social Costs and Benefits; Rights and Duties of Business</td>
<td>04</td>
</tr>
<tr>
<td>02</td>
<td><strong>Professional Ethics in the Marketplace:</strong> Perfect Competition; Monopoly Competition; Oligopolistic Competition; Oligopolies and Public Policy <strong>Professional Ethics and the Environment:</strong> Dimensions of Pollution and Resource Depletion; Ethics of Pollution Control; Ethics of Conserving Depletable Resources</td>
<td>08</td>
</tr>
<tr>
<td>03</td>
<td><strong>Professional Ethics of Consumer Protection:</strong> Markets and Consumer Protection; Contract View of Business Firm’s Duties to Consumers; Due Care Theory; Advertising Ethics; Consumer Privacy <strong>Professional Ethics of Job Discrimination:</strong> Nature of Job Discrimination; Extent of Discrimination; Reservation of Jobs.</td>
<td>06</td>
</tr>
<tr>
<td>04</td>
<td><strong>Introduction to Corporate Social Responsibility:</strong> Potential Business Benefits—Triple bottom line, Human resources, Risk management, Supplier relations; Criticisms and concerns—Nature of business; Motives; Misdirection. Trajectory of Corporate Social Responsibility in India</td>
<td>05</td>
</tr>
<tr>
<td>05</td>
<td><strong>Corporate Social Responsibility:</strong> Articulation of Gandhian Trusteeship Corporate Social Responsibility and Small and Medium Enterprises (SMEs) in India, Corporate Social Responsibility and Public-Private Partnership (PPP) in India</td>
<td>08</td>
</tr>
<tr>
<td>06</td>
<td><strong>Corporate Social Responsibility in Globalizing India:</strong> Corporate Social Responsibility Voluntary Guidelines, 2009 issued by the Ministry of Corporate Affairs, Government of India, Legal Aspects of Corporate Social Responsibility—Companies Act, 2013.</td>
<td>08</td>
</tr>
</tbody>
</table>
Assessment:

Internal Assessment for 20 marks:
Consisting Two Compulsory Class Tests
First test based on approximately 40% of contents and second test based on remaining contents
(approximately 40% but excluding contents covered in Test I)

End Semester Examination:
Weightage of each module in end semester examination will be proportional to number of respective lecture
hours mentioned in the curriculum.

1. Question paper will comprise of total six questions, each carrying 20 marks
2. Question 1 will be compulsory and should cover maximum contents of the curriculum
3. Remaining questions will be mixed in nature (for example if Q.2 has part (a) from module 3 then
   part (b) will be from any module other than module 3)
4. Only Four questions need to be solved.

REFERENCES:

1. Business Ethics: Texts and Cases from the Indian Perspective (2013) by Ananda Das Gupta; Publisher: Springer.
Objectives:
1. To understand Research and Research Process
2. To acquaint students with identifying problems for research and develop research strategies
3. To familiarize students with the techniques of data collection, analysis of data and interpretation

Outcomes: Learner will be able to…
1. Prepare a preliminary research design for projects in their subject matter areas
2. Accurately collect, analyze and report data
3. Present complex data or situations clearly
4. Review and analyze research findings

<table>
<thead>
<tr>
<th>Module</th>
<th>Detailed Contents</th>
<th>Hrs</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td><strong>Introduction and Basic Research Concepts</strong>&lt;br&gt;1.1 Research – Definition; Concept of Construct, Postulate, Proposition, Thesis, Hypothesis, Law, Principle. Research methods vs Methodology&lt;br&gt;1.2 Need of Research in Business and Social Sciences&lt;br&gt;1.3 Objectives of Research&lt;br&gt;1.4 Issues and Problems in Research&lt;br&gt;1.5 Characteristics of Research: Systematic, Valid, Verifiable, Empirical and Critical</td>
<td>09</td>
</tr>
<tr>
<td>02</td>
<td><strong>Types of Research</strong>&lt;br&gt;2.1. Basic Research&lt;br&gt;2.2. Applied Research&lt;br&gt;2.3. Descriptive Research&lt;br&gt;2.4. Analytical Research&lt;br&gt;2.5. Empirical Research&lt;br&gt;2.6 Qualitative and Quantitative Approaches</td>
<td>07</td>
</tr>
<tr>
<td>03</td>
<td><strong>Research Design and Sample Design</strong>&lt;br&gt;3.1 Research Design – Meaning, Types and Significance&lt;br&gt;3.2 Sample Design – Meaning and Significance Essentials of a good sampling Stages in Sample Design Sampling methods/techniques Sampling Errors</td>
<td>07</td>
</tr>
</tbody>
</table>
Formulating Research Problem
5.1 Considerations: Relevance, Interest, Data Availability, Choice of data, Analysis of data, Generalization and Interpretation of analysis

Outcome of Research
6.1 Preparation of the report on conclusion reached
6.2 Validity Testing & Ethical Issues
6.3 Suggestions and Recommendation

Assessment:

Internal Assessment for 20 marks:
Consisting Two Compulsory Class Tests
First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:
Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.
1. Question paper will comprise of total six questions, each carrying 20 marks
2. Question 1 will be compulsory and should cover maximum contents of the curriculum
3. Remaining questions will be mixed in nature (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four questions need to be solved.

REFERENCES:
Objectives:
1. To understand intellectual property rights protection system
2. To promote the knowledge of Intellectual Property Laws of India as well as International treaty procedures
3. To get acquaintance with Patent search and patent filing procedure and applications

Outcomes: Learner will be able to…
1. understand Intellectual Property assets
2. assist individuals and organizations in capacity building
3. work for development, promotion, protection, compliance, and enforcement of Intellectual Property and Patenting

<table>
<thead>
<tr>
<th>Module</th>
<th>Detailed Contents</th>
<th>Hr</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>Introduction to Intellectual Property Rights (IPR): Meaning of IPR, Different category of IPR instruments - Patents, Trademarks, Copyrights, Industrial Designs, Plant variety protection, Geographical indications, Transfer of technology etc. Importance of IPR in Modern Global Economic Environment: Theories of IPR, Philosophical aspects of IPR laws, Need for IPR, IPR as an instrument of development</td>
<td>05</td>
</tr>
<tr>
<td>02</td>
<td>Enforcement of Intellectual Property Rights: Introduction, Magnitude of problem, Factors that create and sustain counterfeiting/piracy, International agreements, International organizations (e.g. WIPO, WTO) active in IPR enforcement Indian Scenario of IPR: Introduction, History of IPR in India, Overview of IP laws in India, Indian IPR, Administrative Machinery, Major international treaties signed by India, Procedure for submitting patent and Enforcement of IPR at national level etc.</td>
<td>07</td>
</tr>
<tr>
<td>03</td>
<td>Emerging Issues in IPR: Challenges for IP in digital economy, e-commerce, human genome, biodiversity and traditional knowledge etc.</td>
<td>05</td>
</tr>
<tr>
<td>04</td>
<td>Basics of Patents: Definition of Patents, Conditions of patentability, Patentable and non-patentable inventions, Types of patent applications (e.g. Patent of addition etc), Process Patent and Product Patent, Precautions while patenting, Patent specification Patent claims, Disclosures and non-disclosures, Patent rights and infringement, Method of getting a patent</td>
<td>07</td>
</tr>
<tr>
<td>05</td>
<td>Patent Rules: Indian patent act, European scenario, US scenario, Australia scenario, Japan scenario, Chinese scenario, Multilateral treaties where India is a member (TRIPS agreement, Paris convention etc.)</td>
<td>08</td>
</tr>
</tbody>
</table>
**Assessment:**

**Internal Assessment for 20 marks:**
Consisting Two Compulsory Class Tests
First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

**End Semester Examination:**
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2. Question 1 will be compulsory and should cover maximum contents of the curriculum
3. Remaining questions will be mixed in nature (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four questions need to be solved.

**REFERENCE BOOKS:**

### Course Code
- **ILO 8028**

### Course Name
- **Digital Business Management**

### Credits
- **03**

#### Objectives:
1. To familiarize with digital business concept
2. To acquaint with E-commerce
3. To give insights into E-business and its strategies

#### Outcomes:
The learner will be able to ……
1. Identify drivers of digital business
2. Illustrate various approaches and techniques for E-business and management
3. Prepare E-business plan

<table>
<thead>
<tr>
<th>Module</th>
<th>Detailed content</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><strong>Introduction to Digital Business</strong>- Introduction, Background and current status, E-market places, structures, mechanisms, economics and impacts Difference between physical economy and digital economy, <strong>Drivers of digital business</strong>- Big Data &amp; Analytics, Mobile, Cloud Computing, Social media, BYOD, and Internet of Things(digitally intelligent machines/services) Opportunities and Challenges in Digital Business,</td>
<td>09</td>
</tr>
</tbody>
</table>
| 2 | **Overview of E-Commerce**  
E-Commerce- Meaning, Retailing in e-commerce-products and services, consumer behavior, market research and advertisement  
EC Strategy and Implementation-EC strategy and global EC, Economics and Justification of EC, Using Affiliate marketing to promote your e-commerce business, Launching a successful online business and EC project, Legal, Ethics and Societal impacts of EC | 06 |
| 3 | **Digital Business Support services**: ERP as e–business backbone, knowledge Tope Apps, Information and referral system  
**Application Development**: Building Digital business Applications and Infrastructure | 06 |
| 4 | **Managing E-Business**-Managing Knowledge, Management skills for e-business, Managing Risks in e –business  
| 6 | **Materializing e-business: From Idea to Realization**-Business plan preparation  
**Case Studies and presentations** | 08 |
Assessment:

Internal Assessment for 20 marks:
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End Semester Examination:
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1. Question paper will comprise of total six questions, each carrying 20 marks
2. Question 1 will be compulsory and should cover maximum contents of the curriculum
3. Remaining questions will be mixed in nature (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four questions need to be solved.

References:

2. E-commerce from vision to fulfilment, Elias M. Awad, PHI-Restricted, 2002
6. Trend and Challenges in Digital Business Innovation, Vinocenzo Morabito, Springer
7. Digital Business Discourse Erika Darics, April 2015, Palgrave Macmillan
8. E-Governance-Challenges and Opportunities in: Proceedings in 2nd International Conference theory and practice of Electronic Governance
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>ILO8029</td>
<td>Environmental Management</td>
<td>03</td>
</tr>
</tbody>
</table>

**Objectives:**
1. Understand and identify environmental issues relevant to India and global concerns
2. Learn concepts of ecology
3. Familiarise environment related legislations

**Outcomes:** Learner will be able to…
1. Understand the concept of environmental management
2. Understand ecosystem and interdependence, food chain etc.
3. Understand and interpret environment related legislations

<table>
<thead>
<tr>
<th>Module</th>
<th>Detailed Contents</th>
<th>Hrs</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>Introduction and Definition of Environment: Significance of Environment Management for contemporary managers, Career opportunities, Environmental issues relevant to India, Sustainable Development, the Energy scenario</td>
<td>10</td>
</tr>
<tr>
<td>02</td>
<td>Global Environmental concerns : Global Warming, Acid Rain, Ozone Depletion, Hazardous Wastes, Endangered life-species, Loss of Biodiversity, Industrial/Ma-made disasters, Atomic/Biomedical hazards, etc.</td>
<td>06</td>
</tr>
<tr>
<td>03</td>
<td>Concepts of Ecology: Ecosystems and interdependence between living organisms, habitats, limiting factors, carrying capacity, food chain, etc.</td>
<td>05</td>
</tr>
<tr>
<td>04</td>
<td>Scope of Environment Management, Role and functions of Government as a planning and regulating agency Environment Quality Management and Corporate Environmental Responsibility</td>
<td>10</td>
</tr>
<tr>
<td>05</td>
<td>Total Quality Environmental Management, ISO-14000, EMS certification.</td>
<td>05</td>
</tr>
<tr>
<td>06</td>
<td>General overview of major legislations like Environment Protection Act, Air (P &amp; CP) Act, Water (P &amp; CP) Act, Wildlife Protection Act, Forest Act, Factories Act, etc.</td>
<td>03</td>
</tr>
</tbody>
</table>

**Assessment:**

**Internal Assessment for 20 marks:**
Consisting **Two Compulsory Class Tests**
First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)
End Semester Examination:
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3. Remaining questions will be mixed in nature (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four questions need to be solved.

REFERENCES:

2. A Handbook of Environmental Management Edited by Jon C. Lovett and David G. Ockwell, Edward Elgar Publishing
5. Environmental Management: An Indian Perspective, S N Chary and Vinod Vyasulu, Macillian India, 2000
Lab Outcome:
1: To design user centric interfaces.
2: To design innovative and user friendly interfaces.
3: To apply HMI in their day-to-day activities.
4: To criticize existing interface designs, and improve them.
5: To Design application for social Task.
6: To Design application for Technical Tasks

Description:
Human Machine Interaction provides the study of user interface and benefit of good design. The design process gives an idea about how people interact with computer and the problems that they fall, so understanding the human characteristics is important as this lays the base for a good interface. It enables the students to apply his/her design skills to develop an appropriate Mobile App or Website. Students also learn the different types of icon, color and its representation with social and ethical concerns. Students can also learn the different software tools used to assemble and build user interface along with the different types of interaction devices and finally try to measure the usability of the application by learning HMI principles.

Suggested List of Experiments:

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Title of Experiments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Problem representation for Designing User Interface</td>
</tr>
<tr>
<td>2</td>
<td>Design a Mobile app/ Website that can teach mathematics to children of 4-5 years age in schools in Rural /Urban Sector</td>
</tr>
<tr>
<td>3</td>
<td>Design a Mobile App/Website that can help people to sell their handmade products in metro cities</td>
</tr>
<tr>
<td>4</td>
<td>ATM machine/KIOSK screen design for rural people.</td>
</tr>
<tr>
<td>5</td>
<td>Design a Mobile App/Website to get an experience for passengers whose flight /train is delayed.</td>
</tr>
<tr>
<td>6</td>
<td>Design an UI application for Institute event management.</td>
</tr>
<tr>
<td>7</td>
<td>Design of User interface for the system using various interaction styles.</td>
</tr>
<tr>
<td>8</td>
<td>Statistical Graphics and its use in visualization</td>
</tr>
<tr>
<td>9</td>
<td>Design appropriate icons pertaining to a given domain .(Eg. Greeting cards)</td>
</tr>
<tr>
<td></td>
<td>Design a personal website for an Artisan</td>
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<tr>
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<td>------------------------------------------</td>
</tr>
<tr>
<td>11</td>
<td>Design a interface for Home appliances</td>
</tr>
<tr>
<td>12</td>
<td>Design an interactive data access using Graphics (QR, BAR Code, Image etc) and generating a print form</td>
</tr>
<tr>
<td>13</td>
<td>Redesign of a user interface (Suggest and implement changes in Existing User Interface)</td>
</tr>
<tr>
<td>14</td>
<td>Design a navigator for a student new in your Institute.</td>
</tr>
<tr>
<td>15</td>
<td>Design a navigator for a person new in tourist city/ village</td>
</tr>
<tr>
<td>16</td>
<td>Design UI for Motor paralysis for disabled people.</td>
</tr>
<tr>
<td>17</td>
<td>KIOSK design for hospital/school/educational campus/National Institute.</td>
</tr>
<tr>
<td>18</td>
<td>To calculate screen complexity of existing Graphical User Interface and redesign the interface to minimize the screen complexity.</td>
</tr>
</tbody>
</table>

**Guidelines:**
1. Students are expected to use advanced tools and Technologies towards execution of lab work.
2. Students can work individually or only 2-3 Students can form a team if they wish to work in Group.
3. Case Study and assignments may be linked with CSC801 Syllabus.

**Term Work:**
Laboratory work will be based on above syllabus with minimum 10(Ten) experiments in line with the above Lab outcomes to be incorporated with 13(Thirteen) lab session of 2 (two) hours each. The problem statement can be decided by the instructor in line with the above list of experiments

**The distribution of 25 marks for term work shall be as follows:**

<table>
<thead>
<tr>
<th>Category</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lab Performance</td>
<td>15</td>
</tr>
<tr>
<td>Mini Project</td>
<td>05</td>
</tr>
<tr>
<td>Attendance (Theory &amp; Practical)</td>
<td>05</td>
</tr>
</tbody>
</table>

**Oral exam** will be based on the above and CSC801:‘HMI Theory’ Syllabus.
### Lab Code
- **CSL802**
- **Lab Name:** Distributed Computing Lab
- **Credits:** 01

#### Lab Outcome:
1. Develop, test and debug RPC/RMI based client-server programs.
2. Implement the main underlying components of distributed systems (such as IPC, name resolution, file systems etc.)
3. Implement various techniques of synchronization.
4. Design and implement application programs on distributed systems.

#### Suggested List of Experiments:

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Title of Experiments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Client/server using RPC/RMI.</td>
</tr>
<tr>
<td>2</td>
<td>Implementation of multi thread application</td>
</tr>
<tr>
<td>3</td>
<td>Inter-process communication</td>
</tr>
<tr>
<td>4</td>
<td>Group Communication</td>
</tr>
<tr>
<td>5</td>
<td>Load Balancing Algorithm.</td>
</tr>
<tr>
<td>6</td>
<td>Name Resolution protocol.</td>
</tr>
<tr>
<td>7</td>
<td>Election Algorithm.</td>
</tr>
<tr>
<td>8</td>
<td>Clock Synchronization algorithms.</td>
</tr>
<tr>
<td>9</td>
<td>Mutual Exclusion Algorithm.</td>
</tr>
<tr>
<td>10</td>
<td>Deadlock management in Distributed systems</td>
</tr>
<tr>
<td>11</td>
<td>Distributed File System</td>
</tr>
<tr>
<td>12</td>
<td>CORBA</td>
</tr>
</tbody>
</table>

#### Term Work:
Laboratory work will be based on above syllabus with minimum 10 experiments to be incorporated.

Laboratory work (experiments): ………………… (15) Marks.
Assignments: ………………………………………… (05) Marks.
Attendance (Theory + Practical)………………… (05) Marks
TOTAL: …………………………………………… (25) Marks.

**Oral exam** will be based on the above and CSC802 syllabus.
Lab Objectives: The course will help the learners to get familiar with

1. Key concepts of virtualization.
2. Various deployment models such as private, public, hybrid and community.
3. Various service models such as IaaS and PaaS.

Lab Outcomes: On completion of the course learners will be able to

1. Adapt different types of virtualization and increase resource utilization.
2. Build a private cloud using open source technologies.
3. Analyze security issues on cloud.
4. Develop real world web applications and deploy on commercial cloud.
5. Demonstrate various service models.

<table>
<thead>
<tr>
<th>Module</th>
<th>Detailed Contents</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td><strong>Title</strong>: Study of NIST model of cloud computing. &lt;br&gt;<strong>Objective</strong>: Understand deployment models, service models, advantages of cloud computing.</td>
<td>2</td>
</tr>
<tr>
<td>02</td>
<td><strong>Title</strong>: Virtualization. &lt;br&gt;<strong>Objective</strong>: Understand different types of virtualizations, Host and bare metal hypervisors and implement horizontal scalability. &lt;br&gt;<strong>Technology</strong>: XEN/ Vmwares EXSi</td>
<td>2</td>
</tr>
<tr>
<td>03</td>
<td><strong>Title</strong>: Infrastructure as a Service. &lt;br&gt;<strong>Objective</strong>: Implement IaaS using your resources. &lt;br&gt;<strong>Technology</strong>: Open Stack / Eucalyptus</td>
<td>2</td>
</tr>
<tr>
<td>04</td>
<td><strong>Title</strong>: Identity Management in Cloud &lt;br&gt;<strong>Concept</strong>: Simulate identity management in your private cloud. &lt;br&gt;<strong>Technology</strong>: Open Stack</td>
<td>2</td>
</tr>
<tr>
<td>05</td>
<td><strong>Title</strong>: Storage as a Service &lt;br&gt;<strong>Objective</strong>: Explore Storage as a Service for remote file access using web interface. &lt;br&gt;<strong>Technology</strong>: ownCloud</td>
<td>2</td>
</tr>
<tr>
<td>06</td>
<td><strong>Title</strong>: Cloud Security &lt;br&gt;<strong>Objective</strong>: Understand security of web server and data directory. &lt;br&gt;<strong>Technology</strong>: ownCloud</td>
<td>2</td>
</tr>
<tr>
<td>07</td>
<td><strong>Title</strong>: Platform as a Service &lt;br&gt;<strong>Objective</strong>: Deploy web applications on commercial cloud. &lt;br&gt;<strong>Technology</strong>: Google appEngine/ Windows Azure</td>
<td>2</td>
</tr>
<tr>
<td>08</td>
<td><strong>Title</strong>: Amazon Web Service &lt;br&gt;<strong>Objective</strong>: To create and access VM instances and demonstrate various</td>
<td>2</td>
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</table>
components such as EC2, S3, Simple DB, DynamoDB.
**Technology:** AWS

| 09 | **Title:** Software as a Service  
**Objective:** Understand on demand application delivery and Virtual desktop infrastructure.  
**Technology:** Ulteo |
|---|---|

| 10 | **Title:** Case Study on Fog Computing  
**Objective:** To have a basic understanding of implementation/applications of fog computing. |
|---|---|

| 11 | **Title:** Mini Project  
**Objective:** Using the concepts studied throughout the semester students shall be able to  
1. Create their private cloud for the institute using the available resources.  
2. Apply security concepts to secure a private cloud.  
3. Implement efficient load balancing.  
4. Compare various virtualization technologies with given resource.  
5. Create cloud applications such as messenger, photo editing website, your own social media etc.  
**Note:** Evaluators must check if students have used appropriate cloud computing tools for their projects. |
|---|---|

**Digital Material**

www.openstack.org

**Text Books:**


**Term Work:**

- Term work should consist of at least 6 experiments and a mini project.
- Journal must include at least 2 assignments.
- The final certification and acceptance of term work indicates that performance in laboratory work is satisfactory and minimum passing marks may be given in term work.
- The distribution of marks for term work shall be as follows:
  - Laboratory work (experiments): ......................... (15) Marks.
  - Mini project.......................... .......................... (15) Marks.
  - Mini Project Presentation & Report.................. (10) Marks
  - Assignments........................................................ (05) Marks
  - Attendance ..................................................(05) Marks
  - TOTAL: .......................................................(50) Marks.

**Practical and Oral** examination will be based on Laboratory work, mini project and above syllabus.

University of Mumbai, B. E. (Computer Engineering), Rev. 2016
Lab Code | Course Name               | Credits
---|--------------------------|---
CSL804 | Computational Lab II     | 1

**Lab Outcome:** After successful completion of this course student will be able to:

1. Acquire practical knowledge within the chosen area of technology for project development.
2. Identify, discuss and justify the technical aspects of the chosen project with a comprehensive and systematic approach.

**Description:**
Design and implementation of any case study/applications/experiments/mini project based on departmental level optional courses using modern tools.

**Term work:**

The distribution of marks for **term work** shall be as follows:

- Lab Experimental Work & mini project : 25
- Report/Documentation/Presentation : 20
- Attendance (Theory & Practical) : 05

**Practical & Oral** examination is to be conducted based on departmental level optional courses by pair of internal and external examiners appointed by the University of Mumbai.
Objective: The primary objective is to meet the milestones formed in the overall project plan decided in Project - I. The idea presented in Project - I should be implemented in Project - II with results, conclusion and future work. The project will culminate in the production of a thesis by each individual student.

Guidelines:

Project Report Format:
At the end of semester a student need to prepare a project report should be prepared as per the guidelines issued by the University of Mumbai. Along with project report a CD containing project documentation, Implementation code, required utilities, Software’s and user Manuals need to be attached.

Term Work:
Student has to submit weekly progress report to the internal guide and where as internal guide has to keep track on the progress of the project and also has to maintain attendance report. This progress report can be used for awarding term work marks. In case of industry projects, visit by internal guide will be preferred to get the status of project.

Distribution of marks for term work shall be as follows:

a) Weekly Attendance on Project Day
b) Project work contributions as per objective
c) Project Report (Hard Bound)
d) Term End Presentation (Internal)

The final certification and acceptance of TW ensures the satisfactory performance on the above aspects.

Oral & Practical:
Oral & Practical examination of Project- II should be conducted by Internal and External examiners approved by University of Mumbai. Students have to give presentation and demonstration on the Project- II.